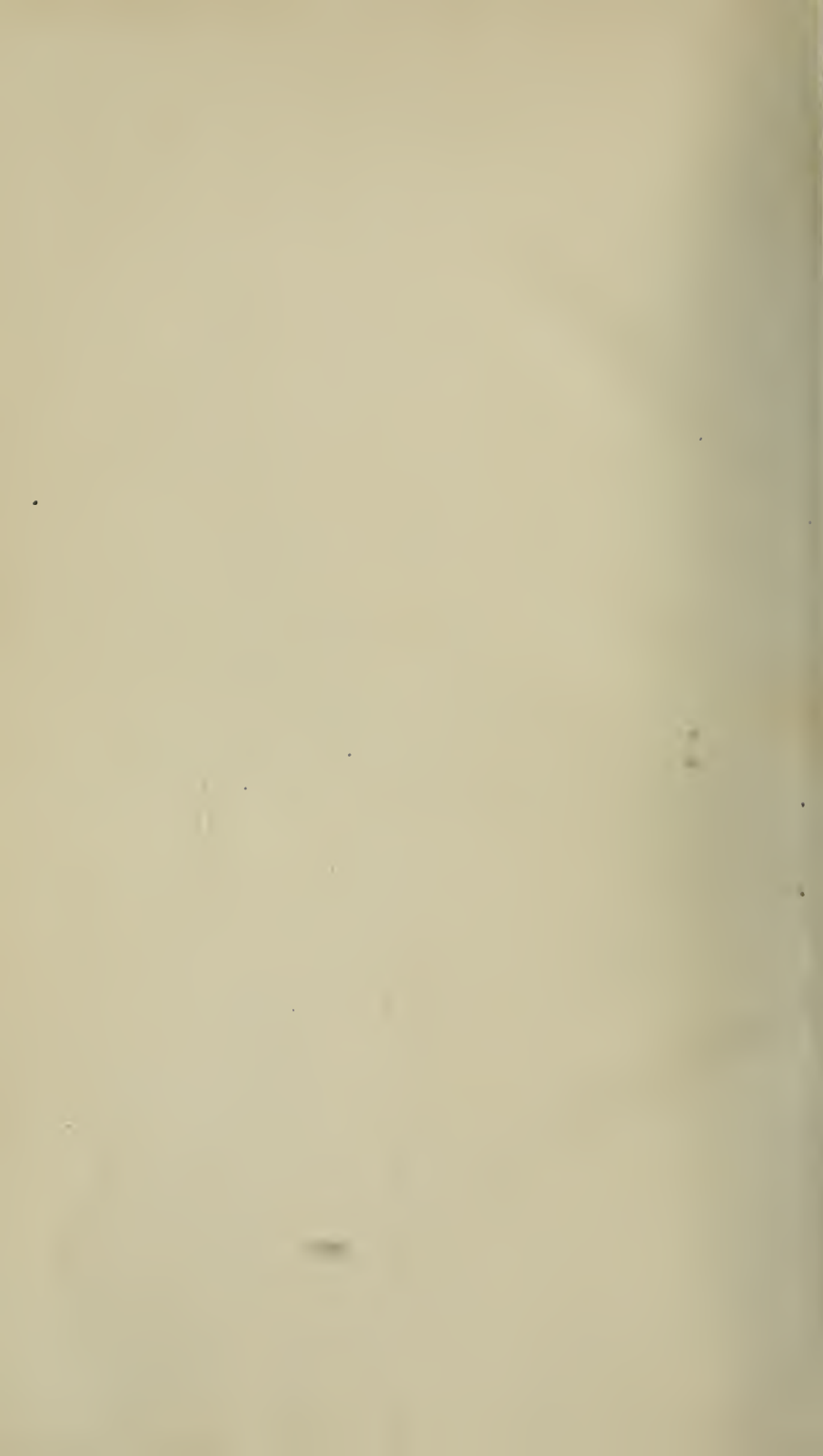




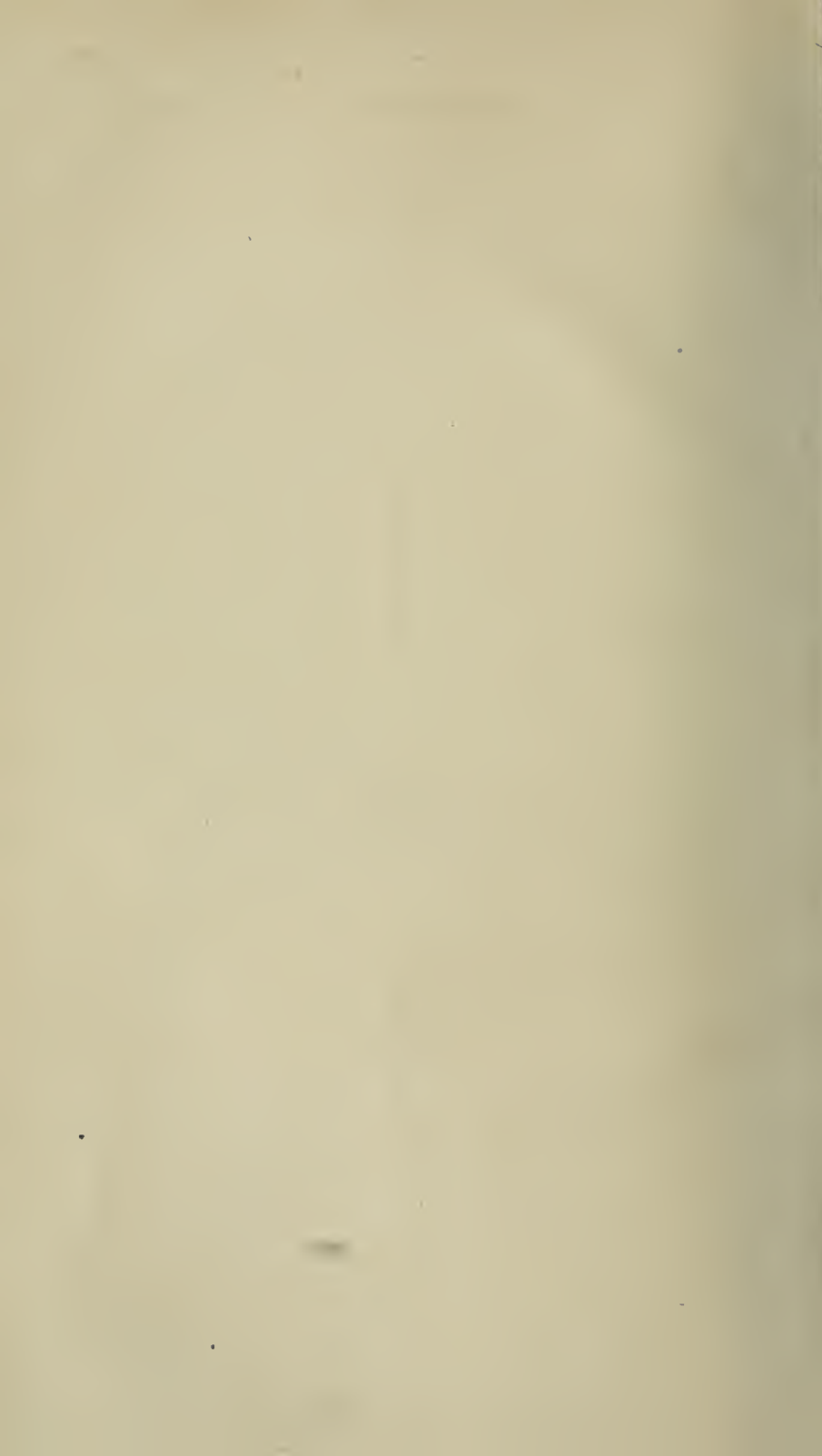












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**JOURNAL**  
OF  
(THE) FRANKLIN INSTITUTE  
OF THE  
State of Pennsylvania  
AND  
MECHANICS' REGISTER.

DEVOTED TO  
MECHANICAL AND PHYSICAL SCIENCE,  
CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,  
AND THE RECORDING OF  
AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED  
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*VOL. 32*  
THIRD SERIES.

VOL. II.

**PHILADELPHIA.**

PUBLISHED BY THE FRANKLIN INSTITUTE, AT THEIR HALL.

1841

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JULY, 1841.

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**Practical & Theoretical Mechanics & Chemistry.**

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*Report of the Committee of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.*

[CONTINUED FROM PAGE 369, VOL. I.]

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**II. UNDERSHOT WHEELS.**

1. *On the ratio of Effect to Power.*—The experiments on undershot wheels were made with wheel No. I., and of course with centre buckets. The aperture was on a level with the tail-way, and the gate closing it was of the form *b*. (Fig. II. Plate IV. Vol. viii., Jour. Frank. Inst.) In the first set of experiments, there were air-vents in the soling of the wheel, through which the water, particularly at high heads, was forced violently, and wasted; and the series is accordingly omitted in the following table. This wasting of the water was from the inadequate size of the vents, as when half the soling of the wheel was removed it did not occur. The heads, apertures, and ratios of effect to power, occupy the successive columns of the table.

## TABLE THIRTIETH.

*Ratio of effect to power in the undershot wheel. Taken from tables S and T. (Vol. ix, Jour. Frank. Inst. p. 154-7.)*

| Table.                     | Head. | Aperture. | Ratio of effect to power. | Ratio for different heads. | Mean ratio. | Remarks.                   |
|----------------------------|-------|-----------|---------------------------|----------------------------|-------------|----------------------------|
|                            | Feet. | Inches.   |                           |                            |             |                            |
| S.                         | 23.00 | 1.00      | .294                      | .294                       |             |                            |
| "                          | 20.75 | 0.75      | .275                      |                            |             |                            |
| "                          | "     | 1.00      | .295                      | .285                       |             |                            |
| "                          | 17.75 | 0.75      | .287                      |                            |             |                            |
| "                          | "     | 1.00      | .292                      | .289                       |             |                            |
| "                          | 4.67  | 1.75      | .262                      |                            |             |                            |
| "                          | "     | 2.00      | .268                      |                            |             |                            |
| "                          | "     | 2.25      | .283                      | .271                       | .285        | Half of soling removed.    |
| T.                         | 20.75 | 1.00      | .296                      |                            |             |                            |
| "                          | "     | 1.25      | .300                      | .298                       |             |                            |
| "                          | 4.67  | 1.75      | .276                      |                            |             |                            |
| "                          | "     | 2.50      | .305                      | .290                       |             |                            |
| "                          | 3.00  | 2.00      | .277                      |                            |             |                            |
| "                          | "     | 2.50      | .272                      | .274                       | .287        | Wheel removed from breast. |
| Mean ratio for high heads, |       |           |                           |                            | .292        |                            |
| " " low "                  |       |           |                           |                            | .278        |                            |
| Average,                   |       |           |                           |                            | .285        |                            |

The average ratio of effect to power appears from this table to be .285. The ratios for the higher heads are decidedly, though not considerably, greater than for lower ones, probably on account of the greater proportion which the effect lost by the water escaping between the wheel and tail-way bears to the whole effect, and which the width of the aperture bears to the head in low heads. All those heads in which the motion of the water was affected by the mode of supplying the forebay (see Plate I. Vol. vii.) have been excluded from the table.

Taking the average ratio of the undershot wheel for comparison with that of the overshot, we find a proportion of 2.98 to one in favour of the latter wheel, approaching nearly to the ratio of three to one.

While in the experiments of Smeaton the overshot wheel appears to have been underrated, the undershot coefficient agrees very nearly with that just deduced; hence our comparison is more advantageous to the overshot wheel than his, in the proportion of 2.98 to 2.

The ratio of effect to power being considered as constant, it follows that *in a given undershot wheel the absolute effect is, under all heads, as the head of water.*

The virtual head wherever the flow of water is regular, is proportional to the real head; hence for a given form of gate, the rule which

is stated is general. When by varying the form we change the velocity of efflux, the effective head varies in the ratio of the square root of the velocity. In the case actually before us, the gate *b* is the one of the four forms used in different experiments which gave the greatest effective quantity of discharge.

It may be satisfactory to show that the head which would result from a calculation of the height due to the velocity of discharge, or virtual head, bore in these experiments a sensibly constant ratio to the real head, as has just been asserted.

The following table, containing the ratios of the observed velocities of the water, obtained from tables R, S, and T, (Jour. Frank. Inst. vol. ix, p. 154-7,) with the velocities calculated upon the heads above the aperture, will serve to show that these ratios vary within moderate limits, which are no doubt those within which the circumstances of the experiments may have varied without being detected.

TABLE THIRTY-FIRST.

*Showing the ratio of the actual to the theoretical discharge under different heads. Gate b, undershot.*

| Table. | Head. | Ratio of actual to theoretical velocity. | Table. | Head. | Ratio of actual to theoretical velocity. | Table. | Head. | Ratio of actual to theoretical velocity. |
|--------|-------|------------------------------------------|--------|-------|------------------------------------------|--------|-------|------------------------------------------|
|        | Feet. |                                          |        | Feet. |                                          |        | Feet. |                                          |
| R.     | 14.75 | 0.82                                     | S.     | 23.00 | 0.79                                     | T.     | 20.75 | 0.78                                     |
| "      | 12.00 | 0.83                                     | "      | 20.75 | 0.75                                     | "      | 4.67  | 0.79                                     |
| "      | 8.00  | 0.95                                     | "      | 17.75 | 0.75                                     | "      | 3.00  | 0.80                                     |
| "      | 2.00  | 0.84                                     | "      | 4.67  | 0.79                                     | "      | 2.00  | 0.77                                     |
|        |       |                                          | "      | 2.00  | 0.78                                     |        |       |                                          |

It is plain, from the manner in which these results vary, as well as from the amount of variation, that there is no sufficient ground to reject the actual heads in favour of heads calculated from the velocities of impulse.

The calculation of the effect by using the actual head, has, therefore, been preferred by the Committee, as more simple than the reference to a virtual head. An examination of table thirtieth will show that except in one case the ratio of effect to power is greater with a greater aperture. This does not arise from any difference in the actual velocity of the water compared with the velocity due to the head,



which might accidentally show some such relation. If the effects were corrected, by taking the virtual heads instead of the real heads, the ratio would rather be increased than diminished. It is necessary to recognise it as a true effect whatever may be its cause.

The truth of these remarks will be rendered more apparent by the following table, in which the actual heads and apertures are registered; the proportional discharges under the same head, but with varied apertures, are compared, and the effects as observed are also compared. Further to show that accidents in the velocity of discharge have not produced an apparent law, the virtual heads due to the velocities are calculated, and the ratios before obtained of effects are corrected according to these heads. A true comparison of effects under the same heads, but with different quantities of discharge, thence results.

TABLE THIRTY-SECOND.

*Comparison of the relative effects under the same head, and with different quantities of water.*

| Table. | Head. | Aperture. | Ratio of quantities discharged. | Ratio of effects. | Virtual head. | Ratio of effects corrected by virtual head. |
|--------|-------|-----------|---------------------------------|-------------------|---------------|---------------------------------------------|
|        | Feet. | Inches.   |                                 |                   | Feet.         |                                             |
| S.     | 4.67  | 1.75      | 1.00                            | 1.00              | 3.08          | 1.00                                        |
|        | "     | 2.00      | 1.20                            | 1.23              | 3.00          | 1.27                                        |
|        | "     | 2.25      | 1.35                            | 1.46              | 2.70          | 1.66                                        |
| T.     | 20.75 | 1.00      | 1.00                            | 1.00              | 12.69         | 1.00                                        |
|        | "     | 1.25      | 1.10                            | 1.13              | 12.50         | 1.16                                        |
|        | 4.67  | 1.75      | 1.00                            | 1.00              | 3.13          | 1.00                                        |
|        | "     | 2.54      | 1.45                            | 1.63              | 2.70          | 1.89                                        |
|        | 3.00  | 2.00      | 1.00                            | 1.00              | 1.89          | 1.00                                        |
|        | "     | 2.50      | 1.17                            | 1.14              | 1.91          | 1.12                                        |

It will be observed in this table that only those experiments have been used in which the aperture was considerably varied. In the first set we have for an increase of 35 per cent. in the quantity of discharge, one of 66 per cent. in the absolute effect, and at a mean with an increase of quantity from 1 to 1.25; the effects increase from 1 to 1.42, or the increase of absolute effect is greater than that of quantity in the proportion of 1.11 to 1. We must admit, then, as a result of experiment, that an increase in the ratio of power to effect may be obtained by an increase in the quantity of water expended, at least under the circumstances in which the water was delivered to the wheel in these experiments. The physical cause of this effect is doubtless the same as that referred to in page 363, Vol. ii., new series, as producing a similar effect in the velocity of an overshot wheel.



By comparing the ratios of power and effect, corresponding to the table just given, it will be found that *when the quantity is increased at a mean twenty-five per cent., the ratio of effect to power is increased but two per cent.*

2. *On the relative velocity of the wheel and water for an undershot wheel.*—The ratio of the velocity of the wheel to that of the water has been deduced in the following table, taken from tables R, S, and T.

TABLE THIRTY-THIRD.

*Showing the relative velocity of the wheel and water in an undershot wheel.*

| Table. | Head. | Velocity<br>of<br>water. | Velocity<br>of<br>wheel. | Ratio. |
|--------|-------|--------------------------|--------------------------|--------|
|        | Feet. | Feet.                    | Feet.                    |        |
| R.     | 14.75 | 25.38                    | 10.86                    | .428   |
|        | 12.00 | 23.01                    | 10.02                    | .435   |
|        | 8.00  | 21.77                    | 11.16                    | .512   |
|        | 2.00  | 9.48                     | 5.92                     | .624   |
| S.     | 23.00 | 30.34                    | 14.46                    | .477   |
|        | 20.75 | 27.32                    | 14.87                    | .545   |
|        | 17.75 | 25.29                    | 13.97                    | .552   |
|        | 4.67  | 13.73                    | 7.68                     | .560   |
|        | 2.00  | 8.86                     | 5.66                     | .639   |
| T.     | 20.75 | 28.53                    | 14.80                    | .518   |
|        | 4.67  | 13.70                    | 7.32                     | .534   |
|        | 3.00  | 11.06                    | 6.26                     | .565   |
|        | 2.00  | 8.73                     | 5.43                     | .622   |
| Mean,  |       |                          |                          | .539   |

This table gives for the mean ratio very nearly what was before obtained in the overshot wheel.

*The ratio of the velocity of the wheel to that of the water is nearly nine-sixteenths.*

The relative velocities in Smeaton's experiments varied between the proportions of one-third and one-half. Oliver Evans gives nearly two-thirds as the result of his practice. It is worthy of remark that Waring's Theory of Undershot Wheels gives one-half for the relative velocities of the wheel and water.\*

A close examination of this table would seem to warrant the inference that as the heads increase, the ratio of the velocity of the wheel to that of the water decreases. This, however, we apprehend is not a fair deduction. The results in relation to the velocity of the

\*Am. Philos. Trans.—old series. Vol. iii, p. 147.

wheel seem by no means so regular as those relating to the proportion of effect to power; but in general it will be seen that where the aperture is increased with a given head, and only the low heads admitted of any considerable increase without throwing too much water against the wheel, the ratio of the velocity of the wheel to that of the water is usually increased. It also appears by the tables that only the larger apertures were used under the low heads, hence the experiments are not precisely comparable, a large aperture giving a greater velocity than a small one would have done. Sometimes the actual velocities of the water, (deduced from the quantities discharged) appear to have increased by an increase in the aperture; but in general the reverse is the case, as will be seen by the following table.

TABLE THIRTY-FOURTH.

*Showing the velocity of the water with different apertures and under the same head.*

| Number. | Head. | Width of aperture. | Velocity of water. | Number. | Head. | Width of aperture. | Velocity of water. | Number. | Head. | Width of aperture. | Velocity of water. |
|---------|-------|--------------------|--------------------|---------|-------|--------------------|--------------------|---------|-------|--------------------|--------------------|
|         | Feet. | Inches.            | Feet.              |         | Feet. | Inches.            | Feet.              |         | Feet. | Inches.            | Feet.              |
| 1       | 20.75 | 0.75               | 25.50              | 5       | 4.67  | 1.75               | 14.08              | 10      | 4.67  | 1.75               | 14.21              |
| 2       | "     | 1.00               | 29.14              | 6       | "     | 2.00               | 13.41              | 11      | 2.50  | 2.50               | 13.20              |
| 3       | 17.75 | 0.75               | 24.59              | 7       | "     | 2.25               | 13.07              | 12      | 3.00  | 2.00               | 11.01              |
| 4       | "     | 1.00               | 29.19              | 8       | 20.75 | 1.00               | 28.69              | 13      | "     | 2.50               | 11.12              |
|         |       |                    |                    | 9       | "     | 1.25               | 28.08              |         |       |                    |                    |

In the first four experiments an increase of velocity attended an increase of opening, in the last two a very slight increase, and in all the others a decrease. As these irregularities run through the series, it would not be proper to base a law upon the mean result.

A comparison of the ratio which the actual discharge bore to the theoretical discharge, with different heads and openings, would not be more satisfactory. While it abundantly appears that an increase of quantity up to a certain point slightly increases the apparent velocity, there is not sufficient reason to deduce a law as to the increase of the latter element by an increase of the former; a conclusion entirely confirmed by general reasoning as to the effect produced by the physical cause to which these phenomena have been satisfactorily traced.

3. *On the effect of air vents in undershot wheels.*—At low heads

air vents are neither an advantage nor disadvantage, but when the water has considerable velocity they produce a waste, from the violent forcing of water through them with the escaping air. The result may be seen by the following tabular view from R, (vol. ix, p. 154,) in which the ratios diminish as the head increases, except in one instance, when the falling off was so rapid as to interrupt the flow.

TABLE THIRTY-FIFTH.

*Centre buckets with air vents in an undershot wheel.*

|   | Head. | Aperture. | Ratio of<br>effect to<br>power. |
|---|-------|-----------|---------------------------------|
|   | Feet. | Inches.   |                                 |
| 1 | 14.75 | 0.75      | .273                            |
| 2 | 12.00 | 1.00      | .284                            |
| 3 | 8.00  | 1.50      | .266                            |
| 4 | 2.00  | 2.00      | .298                            |

The mean ratio for the three higher heads is .274, which is less than the ratios for the higher heads in table twenty-third, in the proportion of 292 to 274, or of 1.07 to 1.

When a sufficient portion of the soling was removed to allow the free and gradual escape of the air, the water was not forced over the soling, even at high heads, and the ratios were raised at high heads, as may be seen in table thirtieth.

4. *On the effect of running an overshot wheel near to a breast.*—Wheel No. I. was in the first two series of experiments at the overshot aperture, retained in the place which it had occupied in the experiments upon the overshot and other apertures, that is, close to the breast. It was subsequently removed six inches from the breast, and a new set of trials made, under different heads.

A comparison of the results when running close to the breast, and when removed from it, is given in the following table, containing experiments from tables S and T, (Jour. Frank. Inst. vol. ix., p. 154-7.) made under the same heads.

TABLE THIRTY-SIXTH.

*Comparison of the effect of an undershot wheel running close to a breast and removed from it. Tables S and T.*

| Head above the<br>bottom of gate. | Head and fall. | Ratio of effect to power. |                |
|-----------------------------------|----------------|---------------------------|----------------|
| Feet.                             | Feet.          | With breast.              | Without breast |
| 20.75                             | 20.75          | .285                      | .298           |
| 4.67                              | 4.67           | .271                      | .290           |
| 2.00                              | 2.00           | .253                      | .281           |
|                                   | Mean,          | .270                      | .290           |

The advantage in every case is in favour of the removal of the wheel from the breast, and at a mean in the ratio of 1.074 to 1.

[TO BE CONTINUED.]

*Account of the Explosion of the Boilers of the Steamboat Henry Eckford.* By THOMAS EWEANK.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN.—You have doubtless noticed the newspaper accounts of the explosion of the boilers of the tow-boat *Henry Eckford*, on the evening of the 27th ult., at one of the docks of this city. The following testimony was adduced before the inquest held the next day over the remains of the only person killed. His death is believed to have been caused by a mass of lead driven violently against his head. It formed part of the sheets upon which the exploded boilers were bedded, and was found lying near him. The Captain of the *Eckford* was wounded, but the engineer and firemen, though close to the boilers, escaped unhurt. All things considered, it is truly wonderful that more lives were not lost on the boat, the surrounding vessels, and on the docks.

*Coroner's Inquest.*—An inquest was held upon the body of Amos Belshow, late of Palermo, Oswego county, who was killed by the explosion of the boiler on board the tow-boat *Henry Eckford*, on Tuesday evening.

The first witness examined was Solomon S. Patchen, master of the canal boat *Henry*, to which the deceased belonged. The *Henry* was lying on Tuesday evening at the foot of Cedar street, and the *Eckford* came there to tow her round into the East river. Witness and deceased were making the *Henry* fast to the *Eckford* when the explosion took place; the *Eckford* had been letting off steam, and the



explosion occurred almost the moment the escape valve was shut. The body of the deceased was found on board the *Henry*.

Mr. Isaac Newton, one of the owners of the tow-boat, deposed that she was built in 1824—that she had a completely new boiler about six years ago—that last fall she was inspected and licensed by the United States Inspector, and that his certificate of her good order was on board—that the boilers were overhauled and stripped about a year ago.

Mr. Newton on his further examination stated, that the *Eckford* was 150 tons burthen, the engine was a compound engine, called "Wolf's Engine," twelve inch high pressure cylinder, and twenty-four inch low pressure, and condensed its own steam—the boilers about thirty inches diameter without return flues, about eighteen feet long—did not remember the thickness of the iron in the boilers. The safety valves were weighted at 150 lbs. for ten years previous to the boat having been used in the harbour, since that they have been reduced, and consequently the pressure reduced.

Mr. George House who has been in the employment of the proprietors of the line of tow-boats to which the *Eckford* belonged, as chief engineer, for ten or fifteen years past—deposed that he was for seven or eight years on board the *Eckford* as engineer—left her in 1834—considered her a safe boat then, and ever since—she never exploded before—she had new boilers in 1829 or 1830 made under the inspection of witness, at the request of the proprietors—the iron was thoroughly tested—the sheets used were all gauged—the sheets were plump quarter inch, called No. 1, which is the strongest boiler iron used.

Mr. House further deposed that the boilers were eleven and a half years old—have been frequently repaired since—has known similar boilers to wear fifteen years—did not see a certificate of inspection on board the *Eckford* since the last repairs.

Charles Maxton, the engineer, deposed that he had been employed on board the *Eckford* since the 25th of March last—that he had examined her machinery, and considered it perfectly competent for the business she was engaged in—that he did not, however, "consider her a safe boat for a heavy head of steam"—that he was on board the boat on the evening of the accident—superintended the getting up of the steam, which occupied about two hours and a half—the means by which he judged of the pressure, was by a weight hung on a lever—witness had examined the weight several times whilst the boat was lying at the dock—the boat had been lying at the dock about twenty minutes when the explosion took place—when the boiler burst, the pressure was about fifty pounds—witness considered that amount of pressure perfectly safe—witness also examined the water

and found it in his opinion sufficient—the explosion took place almost immediately after stopping letting off steam—at the time of the explosion, witness was standing by the engine room, having at that moment tried the water by the gauge cock—never heard any person interested in the boat express any fears of her safety.

Professor James Renwick was examined, and deposed that he was acquainted with the principle of “Wolf’s steam engine,” considered it as safe as any other—the risk depends upon the boiler—witness heard the testimony of the engineers, and so far as their management of the boat was concerned, did not think them chargeable with carelessness—ten years ago, English iron was regarded as the best for boilers—American iron is now considered superior—a boiler of the construction described by preceding witnesses would last a dozen years if carefully repaired—the cylinder form is the simplest and strongest—the flues are the weakest part of the boiler, and one made without return flues is safer than one with them—the diameter was within the size considered safe, being thirty inches. Witness thinks 150 lbs. to the inch beyond a safe limit, but does not think that a dangerous explosion would be likely to take place at 75 lbs.—considered 104 lbs. the maximum pressure that would be prudently employed—witness considered the boiler calculated from twenty-five to forty pounds the safest kind of boiler in use.

Mr. John Clarke, one of the steamboat inspectors appointed under the law of 1838, was next examined. He deposed that he, in conjunction with his associate, Elisha S. Bunker, inspected the Eckford three or four times—the last occasion was on the 1st of October, 1840—a certificate of her competency was then given—would have given her a certificate at that time as a safe vessel for conveying passengers—the law requires an inspection of steamboats once in every six months—intended inspecting the Eckford in a few days and went to look for her on last Saturday for that purpose—the law requires the inspector’s certificate to be hung up in a conspicuous place on board the boats—was informed at the time of the inspection that the Eckford carries fifty or seventy-five pounds—considered that perfectly safe—the usual mode of inspecting the boiler of a steamboat is to examine it by looking through the furnace door—witness is a practical engineer—has been so for upwards of thirty years.

After the testimony has been gone through, the Coroner called the attention of the jury to the great importance of the case, and reminded them that the great object of the tedious investigation before them was to ascertain whether the steamboat was sea-worthy, and had all her machinery, boilers, &c., in perfect repair and order, and also if any blame was to be attached to the captain or engineer, or other

persons engaged in the management of the boat, for culpable negligence, or ignorance on their part.

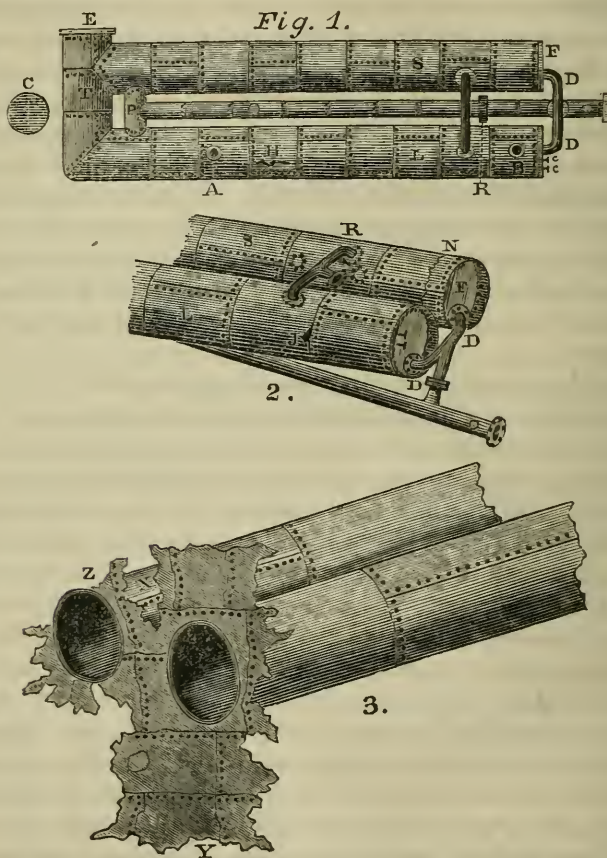
The jury returned the following verdict:—"The jury find that Amos Belshow came to his death by the accidental explosion of the boiler of the steamboat Henry Eckford, on the 27th of April inst. The jury believe that no blame can be attached to the owners, agents, captain, or engineers of the boat, it having fully appeared in evidence that said boat had recently undergone sufficient repairs—and the jury consider that if negligence is chargeable to any persons, it must be to the inspectors appointed by the Government of the United States, who had omitted to inspect the boat and engine, when duly notified by the agent of the owners that said boat was waiting their inspection."

With a view to further the object of the Committee and thereby to subserve the interests of science and of humanity, I have endeavoured to procure such additional information as appeared necessary to understand the whole case. With permission of the person in charge of the boat, the engineer furnished me with three small portions of the boiler, taken from different parts of the end near the chimney; these, with the accompanying sketches and remarks, will enable the Committee to judge of the condition of the boilers, and to comprehend their construction and arrangement—and, with the preceding testimony, to arrive at a pretty correct conclusion respecting the cause of the disaster.

At the time the explosion took place I happened to be in the immediate vicinity, and hastening on board had an opportunity of observing its effects until dark, when the boat, supposed to be in a sinking condition, was removed. It would be difficult, if not impossible, adequately to describe the scene. Portions of the vessel and loads of fire wood that had been blown from her deck, or projected with the chimney and fragments of the engines and boilers into the air, were floating around. Nearly every thing but the heaviest parts of the machinery was swept off into the river, or upon the docks; while such as remained exhibited terrible proofs of the power that is developed in steam. The boilers, which probably weighed four tons, were raised from their bed and thrown nearly thirty feet towards the stern, bearing before them engine house, engine, cranks, wheels, and shafts, &c., as if these had never been secured to either the frame work or beams. So great was the force with which the engine was struck that the large cylinder, bereft of both top and bottom, and not a particle of either flanch remaining upon it, was hurled twenty feet further than the boilers themselves—while the massive cross-head, with the top of the cylinder, the piston and piston rod attached, were thrown several feet further. About two feet of the small cylinder with the



piston and rod within it was leaning against the end of one of the boilers. The cast-iron end of the starboard boiler (marked F in figs. 1 and 2,) was blown into the Captain's office near the stern of the boat, a distance of forty-six feet from its original position on the deck; and although two inches thick, was broken in two, both pieces were drawn out from among the bedding while I was present. But it was towards the bows of the vessel, where the most violent effects had taken place, and where nothing was left to indicate the force which had thus cleared all before it. It was here the chimney was located, (C in fig. 1,) but not a particle was left, the whole was blown into the air and then it fell into the river.



Nothing remained of the short cross boiler, (marked T in fig. 1) to which the ends of the two long ones were united, with the exception of such portions as are shown at fig. 3, and these were straightened out as represented.

The destruction of some, and the displacement of nearly all the machinery, rendered it difficult for a person not previously acquainted with the boat to detect (from the wreck before him) the mode by which the boilers were connected, or the arrangement for feeding them. It was not till the day after the explosion that I became aware of these and some other particulars. It is unnecessary to say any thing here respecting the engine, as its peculiarities are noticed in the testimony before the coroner. I may merely observe that the large cylinder was twenty-four and a half inches in diameter, and that both pistons had metallic packing.

The Henry Eckford had two wrought iron cylindrical boilers—see fig. 1, which represents their upper surfaces as seen from above, and as they appeared before the explosion. They were ranged fore and aft upon the middle of the deck—were nineteen feet long, thirty inches in diameter, and were placed eighteen inches apart. The furnace and fire door were towards the stern of the vessel, and the chimney C, was near the bows. The ends of the boilers over the fire were of cast iron, and connected at their lower parts by the feed pipe D D. R is the steam pipe with a branch and flanch at right angles, to which the one that led to the engine was connected. C C, the gauge cocks. The opposite ends of the boilers were united to a short one T. The larboard boiler L, being connected by a species of elbow joint, while the junction with the other was at the side, as represented. The open part of the short one being closed by a cast-iron end E. Besides being thus connected at their extremities, a passage from the interior of one boiler to that of the other, was formed below the water line, by a short pipe P, nine inches in diameter; and to the middle of this was joined another, O O, which was continued through the furnace and fuel beyond the fire door, where the feed pump was connected to it. This long tube was named *the heater*; its object being to heat the supply water before the latter entered the boilers. The front part of O O, passed through the furnace *below* the pipe D D, to which it was connected by a short vertical one, which I have endeavoured to represent at fig. 2.

There were two valves on the larboard boiler, A B fig. 1. The latter was one inch and three-quarters in diameter. The lever, weight, plug and rod were blown off and lost; nothing but the seat of the valve being left. The other one, A, was two and one-quarter inches in diameter, the distance between the centre of the fulcrum and that of the valve three and a half inches, and the lever four feet long; the weight is lost. As the upper edge of the lever had no notches or other graduated marks, and as the head of the valve rod had only a plain socket through which the lever was loosely slipped, it would

seem that the pressure of the steam could not have been very accurately ascertained, but must have been in a great degree guessed at. The small valve was close to the end of the boiler; it was formerly weighted to blow off at 150 lbs. on the inch, but at the time of the explosion, according to the engineer's account, at fifty pounds. It was named the tell-tale, and when steam escaped from it the other one was opened to let off the excess. It will be perceived that both the safety valves and gauge cocks were attached to the same boiler; no opening being in the starboard boiler S, except for the steam and feed pipes.

The present condition of the boilers may easily be stated. The part T, as already observed, was blown off, leaving the ends of L and S entirely open, with fragments hanging round them. These fragments show that the most part of T was greatly worn, and the texture of the metal deteriorated. Along the edge at Y (fig. 3) is was reduced from one-fourth of an inch, its original thickness, to one-twentieth of an inch, and even less in some places. The specimen No. 1 is from this part. No. 2, a piece that is only two and three-quarter inches in length, and not one and a half in width, exhibits the same or nearly the same extremes of thickness, and was taken from near the place marked X, while the largest specimen is from Z. The lines of separation are, in all instances, through the sheets, and not in the lines of the rivets; this circumstance may be accounted for from the fact that the heads of the rivets protected the metal over which they extended from corrosion, as seen in specimen No. 2, while the rest is, in most cases, worn to extreme thinness.

The end F of the starboard boiler carried with it a complete ring of the metal to which it was riveted, the line of separation being at N, fig. 2. At this place the metal is about its original thickness and appears to be little worse than new. To account for this part giving way, while so much stronger than others, the rupture may be supposed to have been effected on the same principle as that by which the barrel, or breech, of a musket is burst when heavily charged with powder, and the wadding not rammed home. On this supposition a rapid and excessive accumulation of steam must have taken place, and the circumstance of the end F having exploded favours such a conclusion, for had the vapour been gradually evolved, the numerous weak parts of both boilers, one would suppose, would have first given way, or at any rate that the part T would alone have been blown off. The uncertainty respecting the quantity of water in the boilers might also be adduced; for as the engineer tried the gauge cocks the moment after blowing off steam, we know that the foaming of the water consequent on the latter operation would render all *immediate* appeals to the gauge cocks useless—at such a time water would have been given



out had the cocks been placed on the *top* of the boiler. But it is not necessary to seek for the cause of this explosion any further than in the state of the boilers; they are completely worn out. Had the end F not been blown out, and thereby counteracted to some extent the effect of the rupture at T, both boilers would probably have been hurled to some distance from the boat. It is singular that no person was *scalded* with the hot water; neither the engineer, who was standing at the gauge cocks, and was knocked to one side of the boat, nor the fireman, who was partly in front of F, fig. 1, and carried, he knew not how, to the stern of the boat, received any injury. Nor was there any signs of water in the direction which the moving masses took. The end F was shot into the Captain's office, driving the front before it, but no water had followed, since every thing appeared dry when I saw it taken out.

The pipe P of very strong wrought iron, was entirely laid open, and O O, separated from it. The steam and feed pipes, R and D D, were broken and carried away. At H, fig. 1, there was a long rupture in the middle of a sheet, but it had obviously been caused by the sharp edge of some heavy machinery falling on the place. At the edge of the first sheet on the end of the boiler L, fig. 2, and on a level with the water line, is a small triangular hole through the metal, which I have tried to represent at J. Each side of this hole does not exceed three-quarters of an inch, and so far from its having been produced by a blow, it bears every sign of the piece displaced having been *corroded away*. The edges present no signs of fracture, and they are as thin almost as the thinnest specimens sent. Other very thin places have been detected by hammering in the same region.

THOMAS EW BANK.

New York, May 5, 1841.

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## Civil Engineering.

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*Extracts from the Treatise on Geodesy, by L. B. FRANCEUR. Translated by W. H. EMORY, Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 374, VOL. I.]

[Translated for the Journal of the Franklin Institute.]

19. *The Compass*.—This instrument is formed of a box, in the centre of which, supported on a point, is a steel needle, *n s*, (fig. 28. pl. II) rendered magnetic. It is a well known property of the magnetic needle that it takes a direction called the magnetic meridian, which is constant nearly for the same locality, and which does not vary much from that of a line running north and south.

The magnetic needle is a blade of steel, *A B*, (fig. 27,) long, slender, and pointed at the two ends. It receives the magnetic property by rubbing it with a magnet from one end to the other and always in the same direction. A cap of brass, or what is better, a cap of agate, is fitted in the needle, near its centre of gravity, which is scooped out in the shape of a cone, the apex of which rests on a very fine point, upon which the needle traverses with scarcely any friction, and is left free to present its two ends to opposite points in space.

If the needle before being magnetized is horizontal, or balanced when placed on the point, it afterwards takes a direction very much inclined to the horizon, and is brought back to a horizontal position by placing a piece of wax on the end which is uppermost.\* Thus the process of magnetizing causes the needle when freely suspended to take a fixed direction, oblique to the horizon, and in the plane of the magnetic meridian. The inclination being overcome by applying a weight, the needle is left free in the horizontal motion, and takes a direction which at Paris is north-westerly and differs from the true meridian  $22^{\circ}$ . This direction changes with time and place, but for our purposes it is sufficient that it remains the same for many days together, in each locality. The northern and southern ends of the needle are called respectively the north and south poles. They are marked *N* and *S*, or sometimes to distinguish the northern end of the needle it is rendered blue by heat.

The power which determines the horizontal and vertical motion of the needle, seems to be the force of attraction exercised by large masses of iron in the interior of the terrestrial globe, which by the known power of the loadstone to attract iron, forces the needle to take positions in the direction in which this power is exerted.

20. The compass represented in fig. 28, is a smooth square box containing a circle plated with silver, which is divided into three hundred and sixty degrees, and into half degrees. In the centre, and perpendicular to the plate, is a pivot of tempered steel, upon the point of which a magnetized needle, *n s*, turns freely upon its cap, so that the two ends of the needle pass very near the graduated circle without touching it, and enable the observer to read the graduation to which the needle corresponds.

The box is of wood, or of copper; iron is carefully excluded from it; and even the observer must not carry a key or any other article of this metal about him, by which the needle will be made to deviate from the magnetic meridian. The box is fastened together by dovetailing, or by brass screws. A glass fitted over the circle and held

\* Copper wire is generally used in the United States as the counter weight for needles of the surveyor's compass.



in place by an elastic strip of brass, shelters the needle and plate from wind, and is sufficiently near without touching the needle when the compass is horizontal, to prevent it from being thrown off the pivot.

The needles are usually six inches long, and are a little raised at the ends, to give the oscillations more stability, at the same time it takes nothing essentially from the freedom of motion. The pivot is perpendicular to the limb and the bottom of the box, in which it is placed exactly in the centre. The last condition is ascertained by turning the box  $180^\circ$ , and if fulfilled, the points of the needle traverse the same track over the graduated circle.

Upon one of the sides of the box (fig. 15) is an alidade *AB*, movable upon an axis; this alidade has a motion about the axis in a vertical plane when the compass is horizontal; it is formed of a small hollow quadrangular tube, fitted tight against the side of the box and closed at each end by a metallic plate. Each of these plates is pierced with a small hole, and has a verticle tongue above, which takes the place of the thread in the ordinary alidade. Looking at an object through one of these holes, the opposite tongue should appear to coincide with the object. It is necessary that the axis of the alidade should be exactly parallel to the diameter of the circle marked zero and  $180^\circ$ . An axis fitted to the middle of the alidade enables it to revolve in a plane perpendicular to the circle of the compass.

A ball and socket is fixed under the box (fig. 13) and attached to it by a wooden plate with three arms. The two spurs, *a* and *b*, and the small bolt *c*, enter into holes under the box, and fix the plate there by means of the bolt *c*. Thus the compass can be made to take the horizontal position *abc*, and turn freely upon the axis *i*. A clamp screw arrests the motion; and by the aid of a tangent screw, very delicate movements can be given. The instrument is leveled by means of spirit levels attached to the box, or by moving it until both ends of the needle, in an entire revolution of the box, escape contact with the glass cover and retain their position. This is an imperfect mode of leveling, but the degree of precision obtained by observations with this instrument does not require greater accuracy.

When the compass is not in use, the pivot is relieved from the weight of the needle, which is pressed against the glass, by the aid of a small lever, *il*, (fig. 28) one end of which is seen out of the box, and the other end *i*, carrying a ring in contact with the needle.

21. To explain the manner of using the compass in the measurement of angles, it is sufficient to remark that in every position which the box takes in turning on its axis, the magnetic needle preserves a constant direction, (the oscillations of the needle having ceased) as if fixed in space. If the needle reads  $20^\circ$  and  $60^\circ$  in any two positions,

the box and alidade in passing from one to the other has evidently traversed  $40^\circ$ , the difference between  $20^\circ$  and  $60^\circ$ .

Thus, in observing on two distant objects, after the oscillations of the needle have ceased, read each time on the limb the degrees marked by the same end of the needle; the difference of the arcs, passed over by the sight, reckoning from the magnetic meridian, measures the angle of two visual rays drawn from the station to these objects, reduced to the horizon. It would appear, then, that the compass can be used in the same manner as the graphometer in measuring angles and in plotting. It is, however, much less accurate. To lay down a section of country represented by fig. 24, the process is the same as that described in article No. 18.\*

The determination of angles by means of the compass is far from correct; for besides the radius of the limb being small, and seldom reading nearer than to a quarter of a degree, the distance is so great from the graduated arc to the point of the needle, which is easily moved, that it is difficult to ascertain with accuracy the point of coincidence, or in other words, the given angle. The compass is indeed a very imperfect instrument, and is never used when exactness is required; but the use of it is so simple and expeditious that it is generally resorted to in all cases not requiring great precision. After staking signals on the angles of the outline, we proceed by the method of making the circuit, which consists in chaining entirely around the polygon to be surveyed, and measuring all the angles. Place signals at the points A E D C B, (fig. 29;) from A, direct the instrument to E, and read the angle passed over by the instrument from its direction A B, and measure the distance A E; then from E, direct the instrument to D, read the angle measured, and chain the distance E D, and so on around the entire figure, (see No. 26.)

We thus have all the sides and all the angles of the polygon, from which it is easy to plot it on paper; if the work does not close, or in other words, if the last line B A does not fall so as to join E A at the point A, which is usually the case in surveys, made even with this imperfect instrument, we can judge of the extent of the error and make approximate corrections. If any object is remarked, when going round, desirable to be placed on the plot, its position is determined, without the necessity of approaching it, by the method of intersections (explained No. 18.\*)

It is unnecessary, when the compass is used in running courses, that all the signals be seen at the same time; it is sufficient that one alone be visible; for this reason it is the most convenient instrument for

\* See page 373, vol. I, 3rd series, on the use of the Graphometer, which should have been numbered 18.

laying down the courses of a river, the roads of a forest, &c. After placing signals at the principal bends A, B, C, D, &c., (fig. 30,) start at A and direct the instrument on B, then from B direct it on C, from C on the signal D, and so on; read each time the angle made with the magnetic meridian, and measure all the distances A B, B C, C D, &c. The portion of the polygon A B C D can then be constructed as heretofore.

It is not necessary, in the method of making the circuit, to make subtractions to determine the angles A B C, B C D, . . . ; as the magnetic needle always takes a constant direction represented by the parallels, A N, B N, C N, . . . , traced on the plan, and it is sufficient to construct with the protractor the angles N A B, N B C, N C D, . . . which are the same in fact as those read from the compass.

The use of the protractor can be avoided by fixing the sheet of drawing paper, which is to receive the plot, firmly on the table, and placing the box on the paper and turning it until the needle takes the directions successively observed at the different stations. In these positions the box is made to take positions parallel to those at the stations, and the lines drawn with a pencil along the edge, which serves as a rule, are right lines parallel to the visual rays seen through the alidade. To facilitate this operation, the alidade, which is only fixed to the box by a screw which answers as an axis, is removed.

22. Some improvements have been made in the compass. A small telescope is used in place of the alidade, furnished with cross hairs at the focus of the object glass, as described in article 8. One of the hairs should be so placed as to describe a plane parallel to the principal diameter (zero and  $180^\circ$ .) On the outside of the tube, sights are attached. The telescope is used for objects at a great distance, (see fig. 28.)

A small graduated arc of copper is attached to the telescope by means of which the position of the telescope with relation to the horizon is given; so that besides the horizontal angle included between signals, the angular height may be obtained, that is to say, the angle made with the horizon by a visual ray to the signal, (No. 46.)

To place the instrument quickly in adjustment, the universal joint represented in fig. 13, is used; for slight movements, a tangent screw is fitted to the box.

23. *The Plane Table.*—This is another instrument used for projecting plans; it requires scarcely any knowledge of geometry, and is very easy to use. It consists principally of a small rectangular board, 22 by 30 inches on the sides, which can be fixed horizontally on a set of legs. A sheet of paper is stretched on the surface to receive a plot of the work as the successive observations are made. The plane table with its legs, can be carried from place to place, (see fig. 19.)



It is composed of a stand with three legs, surmounted by Cugnot's joint, (No. 13,) by which the table is made horizontal. A spirit level is attached to the table, to indicate if it is horizontal; this may be ascertained also by placing a billiard ball on the table, and if it is horizontal, the ball will remain in repose in any position it is placed.

As a sheet of paper 22 by 30 inches would not, in most cases, be large enough to receive the plot, and as it would be difficult to change the paper, a number of sheets are pasted together and rolled on two parallel cylinders placed under the side edges of the plane table, which are movable about their axes. Each cylinder, or roller, carries a cog wheel, with a click which prevents them turning but in one direction. When necessary to extend the operation of plotting farther, the click is disengaged, the paper unrolled from one of the cylinders and rolled on to the other. For this purpose a key is applied to the axis of the cylinder, which is made square and to project beyond the end. The paper is thus always kept stretched on the table, and is strengthened by being pasted on muslin or silk. To avoid confusion, the rollers are not represented in fig. 19.

The table P P is fastened by four clamp screws, *vv*, to another and smaller table, *pp*, which last is fastened solidly to the joint, and by means of the central axis E turns upon a horizontal disk, *cc*.\*

P P, fig. 19, is the table which carries the plot stretched upon it; *pp* is the second table upon which the first is fixed by four screws, *vv*, at the angles; *cc* is the disk or circular plate fixed at the joint N. The pivot is a large bolt through the centre, the lower end of which terminates in a screw V, with a milled head; after passing through the disk this bolt passes between the lateral bars L L, of the joint. To clamp the table the screw is tightened.

In place of Cugnot's joint, the ball and socket (Figs. 13 and 22) which is lighter and less costly, can be used. There is the disadvantage, however, that it is more difficult to level with, and the table when leveled is disturbed by the slightest pressure.

It is frequently necessary to give a small motion of translation to the upper table; this is done by means of a tangent screw R, which is attached below *cc*. The starting point of the plot should be in a vertical line directly above the corresponding point on the ground. With the aid of a plumb line, or a pebble dropped from under the table, this position is soon obtained.

\*The manner of connecting the plane table with the tripod has been much improved upon in the instruments of recent construction. The improvements consist chiefly in dispensing with the small table *pp*; the adaptation of screws for the purpose of leveling the table, and a contrivance by which the tangent screw can be thrown in or out of play.

24. There are three ways of using the plane table, which are combined together according to the nature of the cases which present themselves. The alidade represented in Figs. 10 and 18, is used for sighting. The end of the dividers, or a needle, is placed at the point on the table, which represents in the plot the place on the ground occupied by the instrument. When directed towards a signal to be projected on the plot, the edge of the alidade is placed against this needle, which serves as a pivot and point of support. A line drawn with a pencil along the edge of the alidade, will be the horizontal projection of the visual ray from the station to the signal.

Before explaining the three methods above referred to, we will explain the method of projecting a triangle,  $RSP$ , (Fig. 25.) Fix the plane table at  $R$  and level it, then direct the alidade to the points  $S$  and  $P$ , and draw in their respective directions, with a pencil, the indefinite right lines  $rp$ ,  $rs$ . This done, remove the plane table to  $S$ , and measure the distance  $RS$ ; then take from the scale which is adopted for the plot, the distance  $rs$ , equal to as many parts as there are units, &c. of measure in the distance  $RS$ , and the point  $s$  on the plot will correspond to the point  $S$  on the ground. Arrived at station  $S$ , place the plane table so that the line  $sr$ , already traced, shall be in the direction  $SR$ , and the point  $s$  on the paper be vertically over  $S$ . The alidade when placed on this line should have its sights directed on the signal  $R$ . From this position turn the alidade about the point  $s$ , until the third point  $P$ , is brought in the line of the sights. Draw the indefinite line  $spP$ , and the point where it intersects  $rp$  is the projection of  $P$ . Thus  $sp r$  is the horizontal projection of  $SPR$ .

With the aid of a protractor and dividers, the dimensions of the angles  $S$ ,  $R$ ,  $P$ , and the length of the sides  $SP$ ,  $RP$  can be deduced from the figure  $spr$ ; from which we see that angles and distances which are inaccessible, can be measured by means of the plane table.

This being well understood, let us explain the three methods of plotting with this instrument.

25. The first is the *method of intersections*, explained page 373, vol. I. The base  $AE$ , (Fig. 24) is measured with a chain, and the plane table is established successively at the two extremities  $A$ ,  $E$ .

A right line  $ae$ , is traced on the paper, equal in distance to  $AE$  when reduced to the scale of the drawing. When the plane table is placed at  $A$ , it must be leveled, and the point  $a$  placed immediately over it, as heretofore explained, and the line  $ae$  must be in the direction  $AE$ .

The alidade is then directed to the signals  $B$ ,  $C$ ,  $D$  . . . , successively, by placing its edge against the needle fixed at the point  $a$ , and turning the alidade around it. As the different positions are taken, the



lines  $ab, ac, ad \dots$ , corresponding with  $AB, AC, AD \dots$ , are drawn. Thus a series of lines is obtained diverging from  $a$ , upon the prolongation of which is found the plot of the signals  $B, C, D$ , &c.

The instrument is then removed to station  $E$ , and is adjusted horizontally so that the point  $e$  shall be exactly over it, and the line  $ea$  in the direction  $EA$ . This done the same operation performed at  $A$  is repeated at  $E$ , that is to say the line  $ed, ec, eb$ , &c. diverging from the point  $e$  are drawn, corresponding to the directions  $ED, EC, EB \dots$ , respectively. These lines intersect the first at the points  $d, c, b$ , &c., which are the representations on the plot of the signal  $D, C, B$ , &c. To avoid confusion and errors in the intersections, write along the lines drawn from  $A$  and  $E$  something to distinguish the particular signal each line corresponds with. After the lines are traced, angles and distances can be ascertained without actually measuring them.

26. The method of *making the circuit*, alluded to in Nos. 18 and 21, is longer but more exact. To plot the polygon (fig. 20) a station is made at every angle. Beginning at  $A$ , the plane table is established according to rules already given. The alidade is turned towards  $E$  and a line traced on the paper in that direction. The distance  $AE$  is measured and laid down on the line  $ae$  just drawn, by means of the scale, and the point  $e$  on the paper represents  $E$  on the ground. Then remove the instrument to  $E$  and adjust it by placing  $e$  over  $E$ , and the line  $ea$  upon  $EA$ ; fixing the plane table in this position, move the alidade along by turning it around  $e$ , and trace the indefinite line which coincides with  $EB$ . The distance  $EB$  is measured as before and laid down on the plot in the line  $eb$ . Thus we proceed from angle to angle until the whole circuit of the polygon is made. On getting back to the station  $A$ , the polygon closes exactly if the work is correct.

This method is the one usually practiced to take the contour of woods, the sinuosities of roads and streams, and whenever from any one of the stations but few of those adjacent can be seen.

27. The third process consists in establishing the plane table at only one station  $C$ , (fig. 26.) This station is generally chosen in the interior of the figure to be plotted, and at such a point that all the other signals can be seen from it. The alidade is directed successively in the directions  $CA, CB, CD \dots$ , and the lines  $Ca, Cb, Cd \dots$  traced on the paper with a pencil. This done, all the distances  $CA, CB, CD \dots$ , are measured with the chain and put down on the paper by means of the scale, and the points  $a, b, d$ , analogous to  $A, B, D$ , are thus determined.

28. With the aid of a declinator, the time required in adjusting the plane table in reference to its bearings, is much abridged. The declinator is a small compass comprised in a long rectangular box, with

the needle having a play of about forty degrees. After the plane table is fixed at the first station as heretofore explained, place the declinator on the table and turn the box until the needle takes the position of zero, then draw a line along the side of the box. When the table is transferred to another station its proper position is given to it by placing the side of the box on this same line, and turning the table until the needle is on the zero point of the graduation. The table is then fixed in the position required for performing the necessary operations, and is the same, or nearly so, as that which would have been obtained by allining the instrument on the preceding station.

29. The explanation given above of the construction and use of some of the instruments used in topography, is sufficient to show the manner of tracing the plan of a city, district of country, park, forest, or any other locality not very extensive. There are many other instruments designed for the same purpose, but they are intended for special cases, and enough has been said to form an idea of the use of them.

Peculiarities sometimes present themselves in the field, which the preceding methods do not provide for, requiring the resolution of triangles to obtain the position of a signal on a plot. An explanation of the means then resorted to is the subject of the following chapter.

[TO BE CONTINUED.]

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*Description of a Plan for Curving Railroad Bars.* By ALFRED C. JONES, Engineer.

TO THE COMMITTEE ON PUBLICATION.

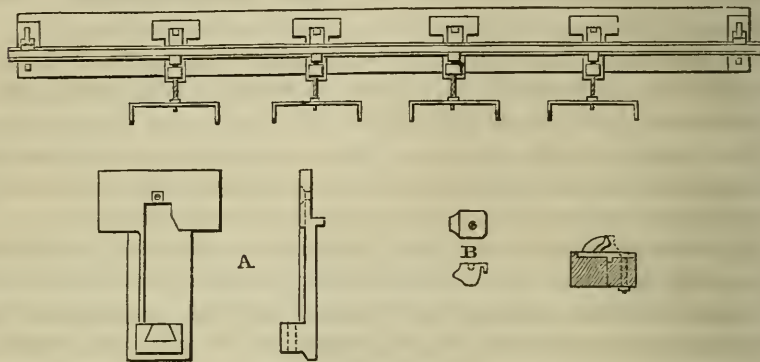
GENTLEMEN.—In connexion with the report on the New York and Erie Railroad, I hereby submit a plan for curving railroad bars; devised by me while engaged on that road.

On all well made railroads, the bars should conform to the curves; this in most cases has been done by springing the bar, and spiking it to its place. This is an imperfect method, for in a short time the running of the cars, assisted by the tendency of the bars to return to a straight line, causes them to become chords, and thereby lessens the smoothness of running and increases the wear and tear. This being understood, I was directed by the engineer of the road to curve the bars previous to laying them.

The methods usually practised for that purpose I discarded, as being too slow in their operation for a due observance of economy; and having often experienced the good effects of the screw as applied to similar purposes, I devised the arrangement as figured. As it will be easily understood, a description of the individual parts is unneces-

sary further than to say that the heads are of cast-iron, (A, one enlarged) the screws of wrought iron, one and an eighth inch in diameter, and a number six thread, the end of the screw being reduced so as to enter a countersunk hole in the back of the follower B, to keep it steady.

The backing heads are seventeen feet six inches apart, and the four others placed at equal distances between them. All being bolted to a hemlock bench, seventeen feet six inches long, eighteen inches wide, and eight inches deep.



*Mode of Operation.*—The bar being placed with its base on the bench, the two end followers are slipped in, and their screws turned to a certain extent; the two middle ones are then run up and the bar forced to a greater distance; this releases the two end screws, which are unscrewed and the followers removed; the two middle ones are then released, and the bar marked on its inner side with a stroke of paint for each eighth of an inch (versed sine) of the curve, this also shows the concave side of the bar, and saves time in sorting for laying. The distance to which a bar is sprung in the machine is usually five inches, this gives a permanent set of about half an inch; the bars are marked with one eighth less than what they stand at, thus  $\frac{1}{2}$  inch |||, meaning three eighths; this is to compensate for a partial straightening of the bar, and it is also better in laying, to decrease than increase the curve.

I will remark that the elasticity differing in bars, the distance to which they should be sprung will depend on the judgment of the operator, some requiring but two inches and others more than five, to retain a permanent set of half an inch.

This machine being in operation only during the most inclement part of the last winter; I am not prepared to say what is the maximum number of bars which can be curved in a day, but with active hands they may be curved as fast as brought to the machine; four hundred have



been curved in a day by two persons attending the screws. The T shape form of the castings is to admit of a larger surface for the outer web to be hammered on when bars are wanted to be adapted to a small curve for temporary tracks. Blocks of wood being interposed between the follower and the bar, it can be forced to any extent; this supercedes the necessity of having the screws made long, which would be an objection in the ordinary working of the machine. For the dimension and form of the bars see the report.

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*Ventilation of Subterranean Works, illustrated by practice at the Pawpaw Tunnel on the Chesapeake and Ohio Canal. By ELLWOOD MORRIS, Civil Engineer.*

Ventilation, whether of buildings or mines, is usually a mere result of the laws of gravity, produced by a disturbance, either natural or artificial, in the equilibrium of the atmosphere at the spot ventilated; whereby a pneumatic current is formed which displaces the foul by fresh air.

It is true that ventilating currents are sometimes produced by setting the air in motion with blowing machines; but this mode of ventilation is so rarely practised in subterraneous works that we do not propose to discuss it here; though we may observe that it is merely one of the means of disturbing the atmospheric balance, and bringing the gravitation of fluids into action to create ventilation.

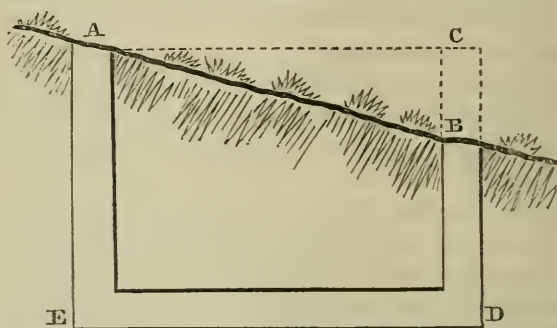
The whole theory of the ventilation of mines is very beautifully and briefly laid down by professor Olmsted in his treatise upon Natural Philosophy, (see vol. ii.)

In the most general terms *ventilation* consists simply in *continually destroying the equilibrium of the atmosphere at the spot we desire to ventilate*, the attraction of gravitation being then brought into play, fresh air moves instantly to restore the disturbed balance, the pneumatic current which produces ventilation is promptly formed and all that we have to do is to arrange our means so as continually to destroy the equilibrium as fast as it is restored, and leave the rest to the operation of the fixed laws which govern the gravitation of fluids.

This result it is generally easy to attain by so planning our works as to bring to our aid some of the immutable laws of nature herself; thus in the case explained by Professor Olmsted, which, as we have before stated, comprises the *fundamental principle* of ventilating mines, though it admits of being acted on in numberless ways by varying our arrangements to suit the particular locality.—Let A E and B D be two shafts, sunk the same depth, E D, (we quote the substance from memory not having the book at hand,) it is manifest that until



joined by the drift E D, the air in both will remain quiescent; but suppose the drift E D to be completed, then during the *summer* the longer column of air A E, being cooled by the surrounding earth, would inevitably preponderate over the shorter column of cold air B D, because the density and of course the weight of the cool column A E, would be greater than that of the compound column of the same height C D, for the portion C B being formed of the summer atmosphere would be warmer and lighter than the air either in B D or A E, both of which would be cooled by the earth, consequently a current of air would continually descend A E, pass along the junction drift E D, and finally rise out of D B.



In the *winter* the reverse of this would take place, and the ventilating current would then descend B D, (for the compound column would at that season be heavier) and passing from D to E ascend E A; and this train of reasoning will hold good by inversion, even in those shafts of vast depths, where the heat of the earth's nucleus would enter as an important element into the disquisition.

Such is the simple principle which produces the perfect ventilation of the most complicated mine; it is only necessary that there should be a single, and but a single, continuous passage to conduct the air to every part of the mine, the beginning and the end of this passage must both be above the surface of the earth, they may be near together or far apart; they may even be at the same level, though the ventilation will be more brisk in proportion as their elevation differs, and though the continuous passage may curve or recurve in its course, no connexion must be opened from one part to another, unless by doors properly constructed to prolong or shorten the distance ventilated, as is often practised in extensive coal workings: in fact every mine must be regarded as one or more syphons inverted, any two communicating air shafts forming the legs of which the apertures are above ground, and we may curve or contort the intermediate part as

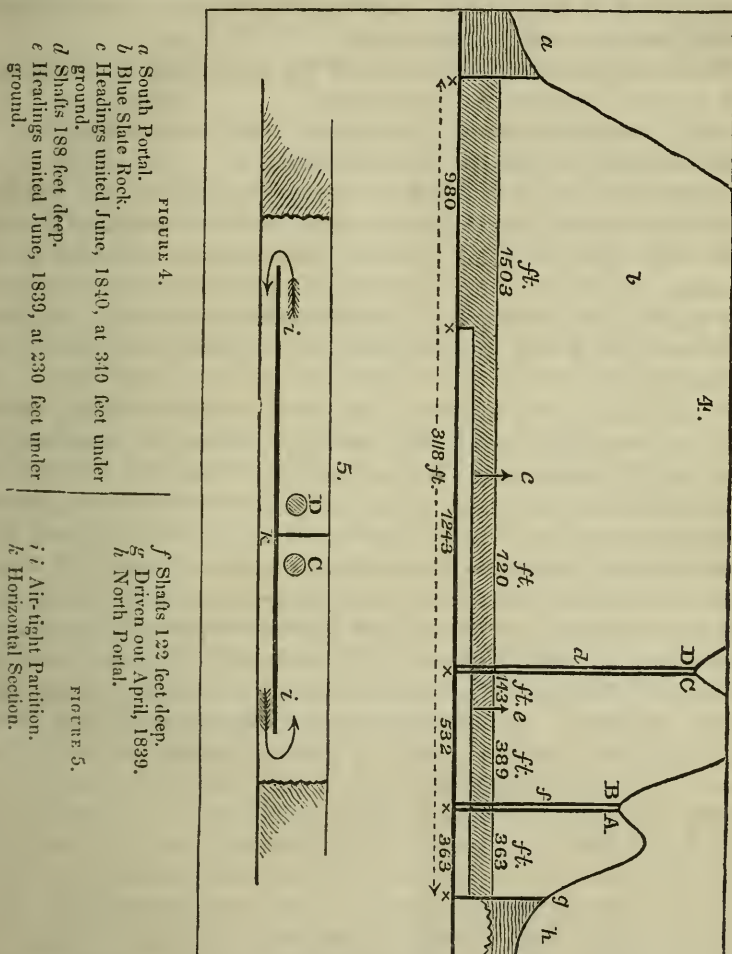
we please, it will in principle remain an inverted syphon still; all that is necessary then to ventilation, is to destroy the equilibrium of the air in this syphon, by diminishing its density in one of the legs, or increasing it in the other, when the pneumatic draught will instantly begin, and continue until the disturbing cause ceases to act.

In sinking the working shafts of the Chesapeake and Ohio Canal Tunnel, they were sunk in pairs, each being eight feet in diameter and fifteen feet clear apart; they were driven down side by side, so that whenever the air became foul in one, a draught hole could be cut to the other, and the inverted syphon being formed, ventilation, induced by the presence of disturbing causes, would promptly begin. It was no uncommon thing in sinking these shafts, for the air at the bottom to become so impure, that the miners would be compelled to stick two or three candles together, in order to procure the ordinary light of one; whenever such became permanently the case, draught holes were cut, and the inverted syphon completed. It would sometimes happen that even after the draught hole was driven through, the air would still so nearly balance in the two shafts as to produce a too sluggish ventilation, and require an artificial disturbing force; in such cases a small fire, built in the draught hole, would immediately accelerate it, and produce a brisk pneumatic current down the shaft furthest from the fire, and up that nearest to it. Thus to determine a flow of air down shaft C and up D, (see Fig. 2,) it was only necessary to kindle a fire in the draught hole close to D, when the air in shaft C, becoming heavier than that in D, (owing to the rarefaction produced by the fire in the latter,) would immediately preponderate, and cause a current to ensue, which would be more or less brisk in proportion to the activity of the fire, or the degree of disturbance of equilibrium produced.

It was only under occasional atmospheric peculiarities that the use of fire became necessary, for although the tops of each pair of shafts were upon the same level, disturbing forces of some sort were usually present; thus—a difference of the number, or animal heat, of the men working in each shaft—an unequal number of buckets of water, or soil, hoisted out—a greater frequency of blasts in one than the other—superior coolness produced by a greater evaporation from the dripping sides of one—and other causes, apparently insignificant, would almost always create a difference in the temperature, and of course in the density of the atmosphere within the respective shafts, sufficient to excite a ventilating circulation; indeed, though frequently down in the shafts, the writer never recollects descending without witnessing a perceptible current of air, which was sometimes quite strong without the presence of fire.



it presents the state of the workings, and the distance of the respective headings from the shafts or portals at the time the workings were united or driven out—immediately previous to which, the writer can state from personal inspection, that no unpleasant effect upon the organs of respiration was perceptible in any part of the headings, and consequently the limit of ventilation was not reached in these tunnel workings.



Indeed we entertain but little doubt that inasmuch as the material wrought engenders no deleterious gas, we might, by bringing fully into action, through the use of air-tight partitions, the principle of the inverted syphon, have proceeded safely with the heading at least a quarter of a mile from the feet of the working shafts.



Fig. 5 exhibits a plan of the partitioning which would have been put in had the air become foul in the workings, and by air-tight partitions upon this plan, or some other device operating upon the same principle, and perhaps also the use of a strong fire, as an auxiliary disturbing force, we repeat the conviction that we might have driven our heading from the shafts nearly, or quite, a quarter of a mile in each direction, which would enable working shafts in similar tunnels to be spaced at *half a mile asunder*, whilst intermediate air shafts would become entirely unnecessary.

Fig. 4 exhibits a vertical section of the tunnel and its shafts, with the points of junction of the headings.

Fig. 5. exhibits a plan of the mode of ventilation designed for the shaft workings, in case the air became foul.

Referring to Fig. 5, D being the wettest and coldest, was designed to be the downcast, and C the upcast shaft; the air descending D would pass in the direction of the arrows, around the partition, close to D's heading, and thence returning on the opposite side of it, pass close to C's heading, and turning again, finally ascend the shaft C. In heavy weather a fire would doubtless have been required at the foot of the upcast shaft.

It will be observed that from the south portal, the heading twelve feet and a half high, was driven 1503 feet inward, the bottoming at the time of junction being 980 feet in, or the tunnel for that distance presenting a section of twenty-five and a half feet altitude, by a width of twenty-seven feet; the atmosphere in the heading remained quite pure and easy to breathe, up to the last moment. Here it will be noticed that the only external disturbing force operating to produce ventilation, was the difference of level between the crown and floor of the tunnel, or twenty-five and a half feet; and yet this and incidental causes kept the air within constantly in motion, and in a state quite fit for respiration. In clear and cold weather, the atmosphere within the tunnel being warmer than that without, the cold air would force in along the floor of the work, and a brisk current, indicated by the floating powder smoke, would be visible, moving out along the roof. On the other hand, in damp and sultry weather, the air in the tunnel, cooled by the rocks, and the evaporation from the wet floor and dripping sides, would become colder than the external atmosphere, and then the smoke from the blasts would roll along the heading floor, and tumbling over the bottom breast like water, be seen flowing out of the tunnel close to the ground; thus indicating that at such times the fresh air was entering along the roof. Of course there were periods (though rarely,) when the atmosphere within and without would approach nearly to equilibrium, and on those occasions the air inside

would necessarily be rather close; but even then the frequent blasting, or even the variation of temperature caused by the motion of the sun, would quickly induce a relieving change, so that no complaint of impure air ever proceeded from the miners of the work; and there is strong reason to believe that in a tunnel of the dimensions of this one, by keeping the bottom breast close up with the heading, a distance of *half a mile* under ground might be driven from an open portal, without requiring any artifice to produce sufficient ventilation. Similar reasoning applies to the heading which was driven south 780 feet from shaft D, without any injurious or oppressive effect upon the lungs being noticed.

In both these cases, and in fact in the whole phenomena of ventilation, as witnessed in the perforation of this tunnel, we trace at once the operation of the simple principle with which we set out, namely, that we can always command a good ventilation whenever we possess the means of *continually destroying the equilibrium of the atmosphere at the spot to be ventilated.*

A perfect illustration of the observations of Professor Olmsted, upon a great scale, was noticed in our tunnel, after the shaft workings had been united together and driven out to the north portal, but before the juncture had been effected between the heading from shaft D, and that entering from the south portal. Throughout the *summer*, the column of air in shafts A and B being colder than the atmosphere at the north portal; and the column in shafts C and D, owing to their depth and increased wetness, being colder than either, a strong draught was found descending shafts A and B, and rushing out at the north portal—whilst a similar current was at the same time flowing down C and D, and from thence passing north to the feet of A and B, and there uniting with the currents of air from them both, would continually pass out at the north portal, bearing along with them the gunpowder smoke from the blasts, at times very briskly. This is precisely the result which Professor Olmsted's reasoning would lead us to expect. And again, during the *winter*, the ventilating currents were reversed, and the air then entering at the north end, was constantly found in a current moving south and ascending by all the shafts. This, too, is a result which was to be anticipated, because during cold weather the temperature of the external air being considerably lower than that of the tunnel and shafts, the outer column would necessarily preponderate, and the colder atmosphere forcing inward, would inevitably produce the southerly flow and ascending shaft currents, which were often noticed by the writer as actually existing during the season of cold.

We are perfectly aware that all we have above stated is as familiar

to the old miner as the flame of his candle; but we have nevertheless thought that there might be many of our readers who may have reflected as little upon this matter as was the case with the writer when his professional duties in connexion with the tunnel we have mentioned brought his mind to bear upon the subject.

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## **Architecture.**

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*On Chromatics as pertaining to Architecture.* By THOMAS U.  
WALTER, *Architect.*

The importance of colour in producing architectural effect renders the subject of chromatics one of peculiar interest, not only to the architect, but to all who are in any way concerned in the construction of buildings. No matter how perfect and beautiful the forms and proportions of an object of taste may be, if the colours of the masses of which it is composed are glaring and inharmonious, the ideas it engenders will be precisely of the same cast; and, even supposing the taste of the spectator to be so well cultivated as to enable him to discern the beauties of its form through the distorting mask of discordant colouring, it will still fail to awaken agreeable emotions of taste.

The art of combining and arranging colours with reference to their operation on the mind, is regulated by laws which depend as decidedly on natural principles as those which govern the composition of sounds in music; and although there may be an endless variety of tastes, both in regard to individual hues, and to styles of composition, it is nevertheless true that any violation of the laws on which the harmony of colouring is founded cannot fail to produce an effect as disagreeable to the eye, as that which a deviation from the laws of harmony in music occasions to the ear; a knowledge of these laws is therefore indispensable to the production of beauty in architecture.

We frequently, however, find individuals totally unacquainted with the laws of harmonious colouring, who, nevertheless, possess a natural taste by which they are unconsciously led, in the arrangement of colours to the most pleasing results; but this taste is like what is termed "a good ear for music" unimproved by a knowledge of the science. We often hear both vocal and instrumental performances by persons who have no knowledge whatever of the laws of harmony; and even admitting such music to be agreeable, which is certainly not always the case, it would not be the less so if the performers understood their art. The same observations hold good in regard to colour. If an individual possesses a natural taste for the harmonious arrangement



of colours, that taste will undoubtedly be confirmed, strengthened, and purified by a knowledge of the natural laws on which chromatics are founded.

All the colours to be found in nature are embraced in three genera, denominated *primary*, *secondary*, and *tertiary*.

The *primary* colours consist of *red*, *blue*, and *yellow*; and of these three, every other colour is compounded, while they themselves are incapable of being produced by the composition of any colours whatever. Sir Isaac Newton has included in the primary colours all the hues which appear on the prismatic spectrum; adding to the *red*, *blue*, and *yellow*, the *violet*, the *green*, the *indigo*, and the *orange*. Sir David Brewster, on the other hand, by a different method of analyzing the prismatic spectrum, infers that it is composed only of red, blue, and yellow—and whatever may be the final judgment of opticians on this point, these are unquestionably the only primary colours of the artist.

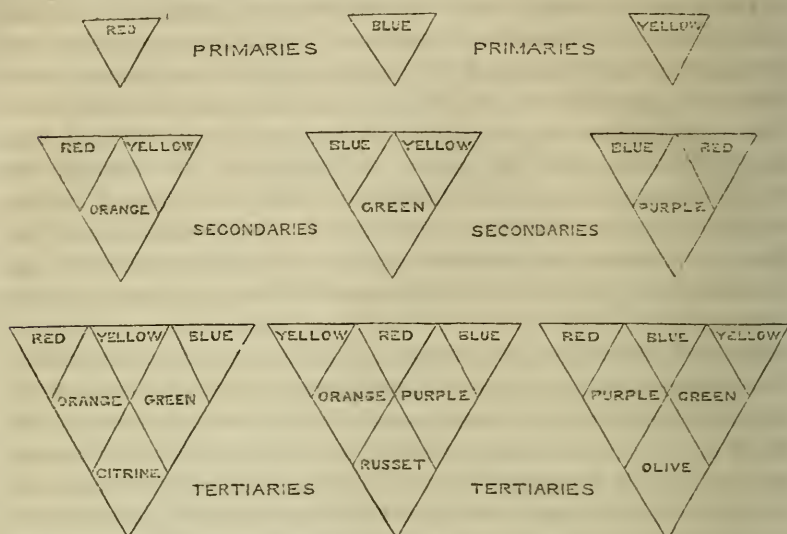
Leonardo da Vinci, in his essay on the beauty of colour, reduces the number of the primaries to *two*, affirming that blue is not a primitive colour because it is composed of light and darkness, as the azure of the sky, which, he remarks, is produced by the transparent body of the air illumined by the sun, and interposed between the darkness of the expanse above; but this explanation is destitute even of plausibility. There can be no doubt that blue is the true colour of the air itself, which it exhibits, notwithstanding its transparency, when seen in large masses. Indeed it must be obvious that if blue is any colour at all, it is most certainly a primitive, as neither of the other colours enter in any degree whatever into its composition.

The *secondary* colours are such only as can be resolved into two primaries; they also consist of three, one of which is *orange*, or a composition of red and yellow; another *green*, or a mixture of blue and yellow; and the third *purple*, or a compound of blue and red.

The *tertiary* colours are those which admit of being compounded of, or resolved into, two secondaries, or the three primaries; they consist of *citrine*, *russet*, and *olive*. Citrine is a compound of green and orange, or of the three primaries with yellow predominating—that colour having entered into the composition both of the green and the orange. Russet consists of purple and orange, or the three primaries with red predominating—for the same reason. And olive is composed of purple and green, or the three primaries with a predominating blue.



These remarks will be exemplified by referring to the following diagram, on which the primaries red, blue, and yellow are first represented singly; secondly, in their binary combinations producing orange, green, and purple; and thirdly, in their triple combinations producing citrine, russet, and olive.



These three genera comprehend all the colours which are positive or definite, and the three colours of each genus, variously compounded, so that neither predominates to the eye, constitute the *neutral* colours, of which white is the most perfect example, being constituted of a combination of all the primitive colours. When, for example, the rays of white light which proceed from the sun are refracted by means of a prism of glass, or by drops of rain, as in the rainbow, they assume all the colours to be found in nature; hence, as the mere interposition of a piece of white glass between the sun and the object upon which it may be shining, cannot by any means impart colour to its rays, the beautiful hues we see can be nothing more than inherent portions of white light.

In view of these considerations, it is obvious that *red, blue, and yellow*, are the foundation of chromatics. These colours are, however, too intense to be employed in their natural and uncompounded state, especially in large masses, as their glaring contrasts are always unpleasant to the eye, and are certain to destroy the beauty of any composition in which they are freely used.

No better example can be referred to in illustration of the disagreeable effects arising from broad surfaces of primitive colours than the red brick fronts of some of our city houses. This crude and fiery colour presents itself in every street, in painful dissonance, with all the tints and hues to which it stands related, and as the consequence, produces an effect exceedingly repulsive to every one whose taste has been trained to a perception of the beautiful. So completely has custom triumphed over the taste of many of our citizens, that even the reddest of red bricks are not yet red enough for them, and we often observe them painting their houses still redder; and then to heighten the incongruity, the joints are carefully pencilled the most glaring white. This is the very worst adaptation that could possibly be conceived of the most unsuitable of all colours for architectural effect. If all brick houses were painted some agreeable *neutral* colours, the appearance of our cities would be improved beyond calculation.

"From the positive nature of *red*," says an excellent writer on chromatics, "there is no colour requires more toning and managing, when exhibited in large masses;" and yet, in American cities, no colour is so lavishly and recklessly used as this. It should also be remarked, that if either of the other primaries were employed in a similar manner, the result would likewise be unpleasant. An agreeable architectural effect can never, under any circumstances, be produced where intense colours are freely used.

Burke, speaking of the effect of colour on the mind, observes that "those which seem most appropriate to beauty are the milder of every sort;" and Mr. Lush, in an essay on beauty in architecture says, "nature teaches us that all vivid and intense colours should be used with a sparing hand;" while Blair affirms that "colours chosen for beauty are generally delicate rather than glaring."

It should further be observed that even in the application of the intermediate hues, the strictest regard should be had to their arrangement, as without suitable contrasts balanced by concord and harmony, any composition will appear monotonous. Mr. Field says, in his Analogical Philosophy: "We acknowledge the power of colours to sooth and delight by gradation of hue and shade, to excite and animate by various contrasts, and to distract and repel by infraction and discordance." And again: "The eye is quiet and the mind tranquil and complacent, when colours are opposed to each other in equivalent proportions chromatically, or in such proportions as neutralize their individual activity."

Our own experience teaches us that in order to allow the mind to pass with pleasure and facility from one image to another—from the impression of one object to that of another—the various effects must

be so harmonized as to leave no glaring object in the composition to arrest the attention, or start an unconnected thought. When, therefore, we seek to achieve effect by violent contrasts in colour, it is evident that the very opposite of beauty must be the certain result.

If, then, the beauty of an architectural object depends upon the harmonious colouring of the masses of which it is composed, it is evident that the same harmony must prevail in all the decorations and furniture of the building, or the composition will fail to be agreeable, even though its architecture be faultless. Hence, no one object in an apartment ought to be allowed to monopolize attraction; but everything should be so toned and balanced in its individual effect, as neither to interfere with the idea of a unity of design, nor tend to monotony.

These obvious deductions from the laws of harmony seem as yet to have been but seldom thought of. Apartments are usually painted without reference to any particular key of colour, and without the slightest regard to the furniture intended for their embellishment—in the choice of which either novelty, or its opposite extreme, the fashion of the day, is too often allowed to usurp the place of taste and reason; thus the most incongruous mixtures are frequently produced, and the effect of apartments which are beautiful in themselves wholly destroyed by the introduction of discordant colours, as well as by inharmonious forms.

Mr. Hays observes, in his excellent treatise on the laws of harmonious colouring, (p. 25,) that “the tone or key of colour is the first point to be fixed, and its degree of warmth or coldness will be regulated by the use, situation, and light of the apartment. The next point (he remarks) is the style of colouring, whether gay, sombre, or otherwise; this is more particularly regulated by the use of the apartment, and the sentiments which it ought to inspire; for as Sir Joshua Reynolds says, ‘what may heighten the elegant may degrade the sublime.’

The tone or key of colour for an apartment should be fixed by the choice of the furniture, as that may be considered in regard to colouring in the same light as the principal figures in a picture. The general tone of the room must, therefore, depend in some degree on the colours of which the furniture is composed; if, for instance, the prevailing colour be blue, grey, cool-green, or lilac, the general tone must be cool; but if, on the other hand, it should be red, orange, brown, yellow, or a warm tint of green, the tone must be warm.” It should, however, be observed, that these remarks relate only to the prevailing tints, as well managed contrasts are as necessary to the beauty of an apartment as they are to the beauty of a picture.

It may, perhaps, be objected, that by thus reducing taste to rule, we circumscribe genius. This might indeed be true of those who,

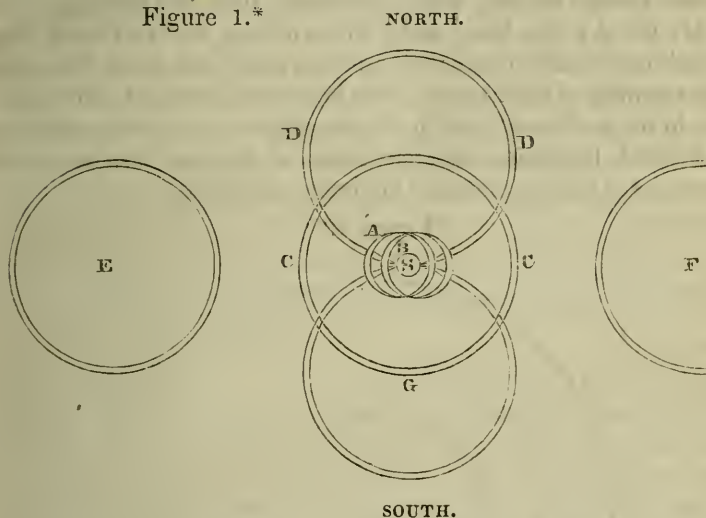


from a want of ability, use rules without a comprehension of their rationale; but rules are founded on reason, and so far from any fetters being imposed on genius by reason, genius itself is the highest possible grade of reason, in a latent state, operating, as it were, unconsciously by natural rules.

## Physical Science.

*An account of some Parhelia observed at Milford and Camden, Delaware, March 14th, 1841. By A. D. CHALONER, A. M., M. D., Recording Secretary of the Academy of Natural Sciences of Philadelphia, &c. &c.*

Figure 1.\*



The following is the account of the parhelia as seen at Camden, seventeen miles northwest of Milford. The day before (13th inst.) was clear, but some two or three days previous there had been some heavy rain. The morning of the 14th inst. the sun rose with unusual brightness with a clear sky; at 8 o'clock, A. M., the sky appeared to grow ropy, with uneven crossings in all directions, which first attracted attention. At 8½ o'clock the sun was surrounded with a circle, which then became of a dim appearance and of a *white* color; at 9 o'clock two circles, A B, appeared, with a *halo* around the sun, as represented by the letter S, fig. 1. A similar circle, G, was formed in the south, and in about ten minutes was completed, and at the same time the circles C, D, and E, appeared in like manner. At 9½ o'clock

\* For this description and drawing I am indebted to the kindness of A. Jackson, Esq., of Camden, Delaware, through Mr Thomas Oliver, of Philadelphia.

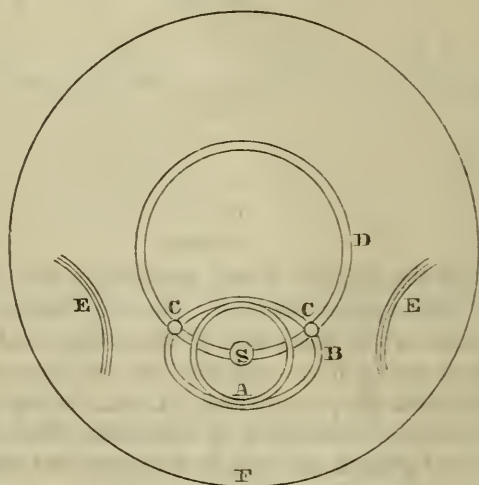


the circle F appeared in like manner; the color of all the circles was of a *sky red*, with the outer edge more of the tint of a rain-bow; in *ten minutes* more, they were of their brightest colors; at 9½ o'clock the circles were all full. The circle F never appeared to be a *full* circle; the altitude of the circles A and B gave an angle of 29°, though somewhat oval, caused by the shadow over them. The circles G, C, and D, cutting the sun's centre, gave each an angle of 69°. The circle E, from its nearest point to the sun, gave an angle of 75°, while F gave an angle of 32°; these circles stood due east and west from the sun, G and D due north and south.

At 10 o'clock the circles disappeared gradually, and at 10½ o'clock they had vanished as they came on; at 12 o'clock there remained one circle around the sun, which continued until the evening. The next day the sky was hazy, and a storm of rain, hail and snow came on which lasted three days, with a strong north-east wind. The wind on the morning of the 14th inst. was light south-west, at 10 o'clock it shifted to the north-east, and in the afternoon it was strong north-east.

At Milford, Delaware, the appearance of the sun was somewhat different, as is evident from the following description.

Figure 2.\*



Imagine a brilliant white circle, D, fig. 2, having the zenith for its centre, and passing through the body of the sun, then a beautiful double iris, A and B, (in figure resembling the telescopic appearance of Saturn and his ring,) encircling the sun, S. Then two parhelia, C C, at the intersections of the circles, in splendor rivaling the great

\* This account and drawing is by David Straughn, Esq., of Milford, Delaware.

luminary himself; then parts of two great circles, E E, of a rainbow color, pointing to the horizon, F, and you have an idea, and only an idea, of the transcendent scenery of the heavens, at once beautiful and sublime, equally calculated to excite the fears of the ignorant, who view it as an omen of disaster, and the admiration of the intelligent, who regard it as the result of the laws of nature. This phenomenon was first observed at 9½ o'clock A. M., and continued until 10 o'clock A. M. The sky was free from clouds, but the atmosphere was hazy, the weather was mild and calm. It was not seen more than fifty miles distant from Milford; it was preceded by a shower from the north-west which cleared up with a brilliant sunset. On the 17th inst. an unusually severe snow storm for the season took place.

Another observer at Milford, Delaware, remarks that the sky was hazy on the 14th of March, at 10 o'clock A. M., without any appearance of clouds, the sun was of a whitish color and pale; so pale or dim that the shadow of an object that intervened could barely be seen. There were two circles around the sun, and in the first circle were *four parhelia*, colored with all the colors of the rainbow.\*

The parhelia appeared to be east and west, north and south in the first circle, at the westerly one there was an arch in the form of a rainbow extending to the north-west, but of a yellowish white color. For an explanation of this phenomenon the reader may consult Brewster's Optics, page 227-260.

On examining the monthly meteorological reports for March, 1841, made to the Franklin Institute, from the different counties of Pennsylvania, I find that from the 14th to 17th of March there was an unusual prevalence of *stormy weather*, rain and snow of great depth, but at Silver Lake, Pennsylvania, vice versa, being dry, fine and clear; a similar state of weather being observed on the 14th inst. at Milford and Camden, Delaware, where the above appearances were observed.

At Little Creek landing, Kent county, Delaware, about three miles east of Dover and two miles from Delaware Bay, on March 15th,† 1841, the following appearances were observed by Mr. Charles P. Hayes.

"There was, in the first place, a very large circle around the sun which was intersected by two others whose tangents were the centre of the sun, each having a central bright spot, resembling the sun shin-

\* I am indebted to Mr. Thomas Oliver, of Philadelphia, for his kindness in procuring information for me upon this subject.

† There is *probably* a mistake in this date (15th inst.) as the *parhelia* were observed at Milford and Camden, Delaware, at the same time, March 14th; all other accounts coincide as to the time.

ing through a thin cloud. But one of the most striking points in the scene was a beautiful rainbow *immediately under the sun*, which at this time shone bright and warm, the sky being almost clear.

On Wednesday afternoon, the 17th inst., a heavy snow storm took place.

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*Remarks relating to the Tornado which visited New Brunswick, in the State of New Jersey, June 19, 1835, with a Plan and Schedule of the Prostrations observed on a section of its track.*  
By W. C. REDFIELD, Esq.

Communicated by the Author.

In a paper printed in the American Journal of Science, in which I referred to the support given by Prof. Bache to Mr. Espy's theory of storms, at the meeting of the British Association in 1838, founded upon observations made on the New Brunswick tornado, I have stated, that in my own examinations I had observed numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the whirling vortex at the surface of the ground; and further, that the direction of rotation was *towards the left*, as in the North Atlantic hurricanes.\* It was due to Professor Bache that my observations should be brought forward; a task which has been too long delayed, partly from a desire that he would revise his former conclusions. The facts now presented form part of the evidence to which I then alluded.

If the effects which I present for consideration be due to "a moving column of rarefied air without any whirling motion at or near the surface of the ground," as maintained by Professor Bache,† we might expect to find a relative uniformity in these effects on the two opposite sides or margins of the track. How far this is the case may be seen by inspecting the observations which are found upon the annexed plan of prostrations.

The occurrence of these tornadoes appears to have been noticed from the earliest antiquity; and their violence has been considered as the effect of an active whirling motion in the body of the tornado: this peculiarity of action having often been supported by the testimony of eye-witnesses.

The whirling motion, however, has not been recognized by Prof. Bache, Mr. Espy,‡ or Prof. Walter R. Johnson,|| in their several

\* American Journal of Science, October, 1838, vol. xxxv, pp. 206, 207.

† Transactions of the American Philosophical Society, vol. v, p. 417, New Series.

‡ Transactions of the American Philosophical Society, vol. v, New Series.

|| Journal of the Academy of Natural Sciences of Philadelphia, vol. vii, part ii.



accounts of the New Brunswick tornado; these writers having been led to adopt or favour a theory of ascending columns in the atmosphere, founded on the supposed influence of calorific expansion accompanying the condensation of vapor.

It is remarkable that previous to this period the evidences of the rotation, or other characteristic action, of tornadoes appear not to have been duly examined and recorded, nor even to have received the distinct consideration of scientific observers. We are therefore left to seek out the peculiarities of their action, by examining the direction of the prostrations and other effects of the wind; and from a careful induction from the effects which are thus registered as by the finger of the tornado, we may hope to arrive at satisfactory conclusions.

If the numerous prostrations of trees and other objects, which may be observed in the path of a tornado, be the effects of a violent whirlwind, it appears most reasonable to infer that this whirl had the common properties which may be observed in all narrow and violent vortices, viz: *a spirally descending and involuted motion* of the exterior and lower portions of the vortex, rapidly quickened in its gyrations as it approaches toward the centre or axis of the whirl, and thence continued (in the case of the whirlwind) spirally upward, but gradually expanding in its spiral course by an evolute motion in ascending towards the extreme height of the revolving mass.

If we now contemplate the action of this whirling body, while in a state of rapid progression, on the several objects found in distinct portions of its path, we may expect to witness effects of much complexity, particularly as regards direction; and, also, that amid this apparent complexity, some clue may be obtained that will serve to indicate or establish the true character of its action. Some of the effects which may be expected, or observed, will be here considered.

1. We may expect to find, in the path of the whirlwind, strong evidence of the inward or vorticular course of the wind at the earth's surface; the violence of which inward motion is clearly indicated by the force with which various objects, often of much weight, are carried spirally upward about the axis of the revolving body.

Now the effects of this inward vorticular motion at the surface of the ground, are clearly manifested in the cases before us; and are also well illustrated by Prof. Bache, in his paper on this tornado, although referred by him to a different action.\*

2. As the effects which may be observed at various points in the track were produced at different moments of time, and by forces acting in different directions, as well as of various intensities, we may expect to find great diversities in the several directions of the fallen trees and other prostrated bodies; and further, as all the forces, in

\* Transactions of the American Philosophical Society, vol. v.



addition to their inward tendency, have likewise a common tendency in the direction pursued by the tornado, we may expect to find, also, full evidence of this progressive force in the direction of the fallen bodies.

These effects, I need hardly state, are distinctly observed in the case before us; and appear likewise from the observations of Professor Bache. The results already noticed have been observed also in the tracks of other tornadoes: so that a general inclination, both inward and onward, amid the various and confused directions of the fallen bodies, is distinctly recognized by all parties to this inquiry.

3. It has been often noticed, that where two fallen trees are found lying across each other, the uppermost or last fallen points most nearly to the course pursued by the tornado.

In view of the facts above stated, much pains have been taken to establish, by induction, a central and non-whirling course in the wind of the tornado; first inward and then upward, like that resulting from a common fire in the open air. I do not propose to notice the insuperable difficulties which appear to attend this hypothesis. It is important to state, however, that all the above mentioned effects, when theoretically considered, are, at least, equally consistent with the involute whirling action of an advancing vortex. This important consideration I have not seen recognized by the advocates of the non-whirling theory; and it seems proper, therefore, to point out, as we proceed, other and more distinguishing effects of the whirling action.

4. It has been noticed, also, that the directions given to broken limbs and other bodies, by the successive changes in the direction of the wind as the tornado passed over, have been found in opposite courses of change, on the two opposite sides of the track.

This fact, too, has been strongly urged as disproving a rotary motion. But, unfortunately for the objection, this effect accords fully with the rotary action of a progressive mass of atmosphere; as is well known to all who clearly understand the *theory* of rotary storms.

In all such whirling masses the successive changes in the direction of the wind *result solely from their progressive motion*, and necessarily take place in opposite directions or courses of change on the two opposite sides of the advancing axis. This indication fails, therefore, as a theoretic test; and I now proceed to notice others, which are peculiar to a progressive whirling action.

5. In considering further the effects of such action, we may expect to find that the greatly increased activity of gyration which is always observed near the centre of a vortex, will be indicated by a more violent and irregular action in and near the path pursued by the axis of the whirlwind, than is found under its more outward portions.

This effect is often strikingly exhibited in the path of tornadoes; while, in the supposed ascent of a non-whirling column, it would seem that no part of the surface would be so much exempted from its action, and particularly from its power of prostration, as that lying near its centre.

6. As the effect of rotation must be to produce, on one side of the advancing axis, a reverse motion which is contrary to the course of the tornado, it is evident that on this side the prostrating power will be much lessened; that the cases of prostration, therefore, will be here less numerous; and that some of these, at least, will be produced in a backward direction, more or less opposite to the course of the tornado. By this criterion, not only the whirling movement, but the direction of the rotation also, may be clearly ascertained.

This effect is best observed by comparing the two opposite margins of the track, and is strongly exemplified in the case before us. Here we find, that most of the trees prostrated within five chains (110 yards,) from the northern or left-hand margin of the track, lie in directions which are more or less backward from the course of the tornado. The prostrations in this part of the track are also for the most part less general than on the opposite side of the axis,\* a greater portion of the trees being left standing.

It sometimes happens, owing perhaps to the inward or involute motion having exceeded the progressive motion at a particular point, that some inclination backward will be found in the prostrations on the progressive side of the whirl, as seen on the sketch, Nos. 77 to 80. But these unfrequent cases by no means compare with the numerous backward and sometimes *outward* prostrations, found on the reverse side of the whirl, as illustrated by Nos. 1, 3, 4, 7, 9, 10, 12, 13, &c. on the left side of the track. Thus we find here a satisfactory indication that this tornado was a whirlwind; and that the course of its rotation was to the *left* in front.

7. It is also apparent, that the prostrating power of a whirlwind on the side of its reversed motion as just considered, will be limited to a shorter distance than on the opposite or progressive side of its axis.

This is seen in the more limited *extent* of the prostrations on the north or left margin of the track, as compared with the extent of those which incline inward on the right side of the apparent axis. There were many trees standing beyond the northern border of the track, but none had fallen.

\* There was a vacant space in the belt of wood, immediately to the right of the line *c c*, or axis of the tornado, owing to which the effect mentioned does not appear so obvious in the figure.

## SCHEDULE OF THE PROSTRATIONS

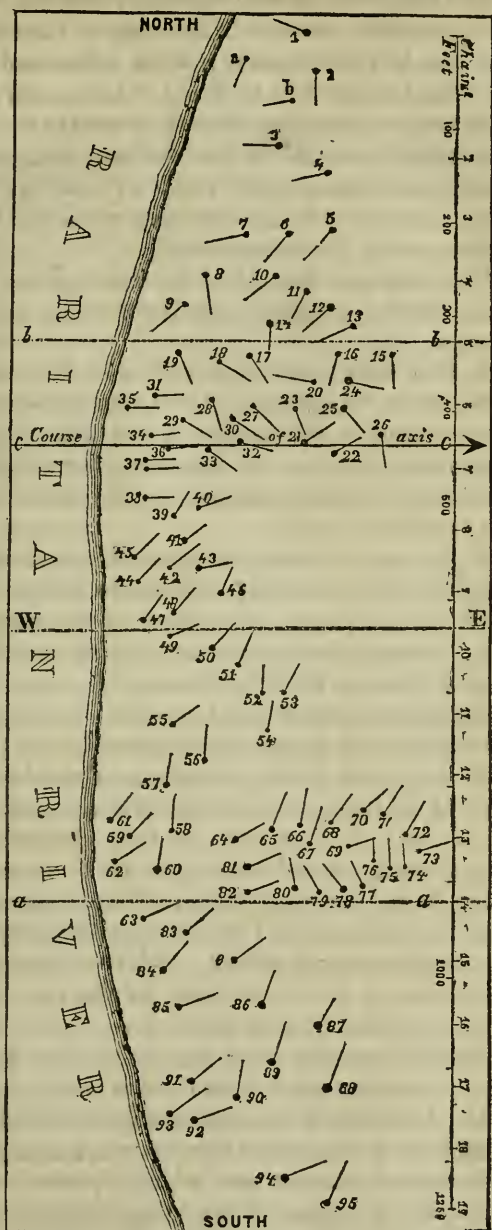
Observed on a Section of the Track of the New-Brunswick Tornado, of June 19th, 1835.

| No.                                                                                                         | Direction of Prostration.                                                   | Inclination. | No.                                                                                                                             | Direction of Prostration.   | Inclination. |
|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------|
| TABLE I.<br>Left side of the track to the line<br><i>b b</i> —5 chains.                                     |                                                                             |              | TABLE IV.<br>Right side of axis, from line <i>W E</i><br>to line <i>a a</i> —4½ chains.                                         |                             |              |
| <i>a</i>                                                                                                    | Tree lies S. 20° W. . .                                                     | 110°         | 49                                                                                                                              | Tree lies N. 67° E. . .     | 23°          |
| <i>b</i>                                                                                                    | .. .. S. 80 W. . .                                                          | 170          | 50                                                                                                                              | .. .. N. 45 E. . .          | 45           |
| 1                                                                                                           | .. .. N. 67 W. . .                                                          | 203          | 51                                                                                                                              | .. .. N. 22 E. . .          | 68           |
| 2                                                                                                           | .. .. S. . . .                                                              | 90           | 52                                                                                                                              | .. .. N. 3 E. . .           | 87           |
| 3                                                                                                           | .. .. W. . . .                                                              | 180          | 53                                                                                                                              | .. .. N. 30 E. . .          | 60           |
| 4                                                                                                           | .. .. S. 80 W. . .                                                          | 170          | 54                                                                                                                              | .. .. N. 10 E. . .          | 80           |
| 5                                                                                                           | .. .. S. 40 W. . .                                                          | 130          | 55                                                                                                                              | .. .. N. 35 E. . .          | 55           |
| 6                                                                                                           | .. .. S. 40 W. . .                                                          | 130          | 56                                                                                                                              | .. .. North . . .           | 90           |
| 7                                                                                                           | .. .. S. 80 W. . .                                                          | 170          | 57                                                                                                                              | .. .. N. 10 E. . .          | 80           |
| 8                                                                                                           | .. .. S. 10 E. . .                                                          | 80           | 58                                                                                                                              | .. .. N. 3 E. . .           | 87           |
| 9                                                                                                           | .. .. S. 50 W. . .                                                          | 140          | 59                                                                                                                              | .. .. N. 45 E. . .          | 45           |
| 10                                                                                                          | .. .. S. 50 W. . .                                                          | 140          | 60                                                                                                                              | .. .. N. 10 E. . .          | 80           |
| 11                                                                                                          | .. .. S. 26 W. . .                                                          | 116          | 61                                                                                                                              | .. .. N. 35 E. . .          | 55           |
| 12                                                                                                          | .. .. S. 50 W. . .                                                          | 140          | 62                                                                                                                              | .. .. N. 60 E. . .          | 30           |
| 13                                                                                                          | .. .. S. 65 W. . .                                                          | 155          | 64                                                                                                                              | .. .. N. 40 E. . .          | 50           |
| 14                                                                                                          | .. .. South . . .                                                           | 90           | 65                                                                                                                              | .. .. N. 20 E. . .          | 70           |
| Mean direction, 16 cases, S. 48° W.<br>Mean inclination from course, in-<br>ward and backward, 138 degrees. |                                                                             |              | 66                                                                                                                              | .. .. N. 10 E. . .          | 80           |
| TABLE II.<br>Left side of the axis, from the line<br><i>b b</i> to <i>c c</i> —1½ chains.                   |                                                                             |              | 67                                                                                                                              | .. .. N. 20 E. . .          | 70           |
| 15                                                                                                          | Tree lies S. 2° E. . .                                                      | 88           | 68                                                                                                                              | .. .. N. 40 E. . .          | 50           |
| 16                                                                                                          | .. .. S. 12 W. . .                                                          | 102          | 69                                                                                                                              | .. .. N. 70 E. . .          | 20           |
| 17                                                                                                          | .. .. S. 35 E. . .                                                          | 55           | 70                                                                                                                              | .. .. N. 50 E. . .          | 40           |
| 18                                                                                                          | .. .. S. 62 E. . .                                                          | 28           | 71                                                                                                                              | .. .. N. 35 E. . .          | 55           |
| 19                                                                                                          | .. .. S. 25 E. . .                                                          | 65           | 72                                                                                                                              | .. .. N. 30 E. . .          | 60           |
| 20                                                                                                          | .. .. N. 80 W. . .                                                          | 190          | 73                                                                                                                              | .. .. N. 50 E. . .          | 40           |
| 23                                                                                                          | .. .. S. 20 E. . .                                                          | 70           | 74                                                                                                                              | .. .. North (two) . .       | 90           |
| 24                                                                                                          | .. .. S. 80 E. . .                                                          | 10           | 75                                                                                                                              | .. .. North " . .           | 90           |
| 25                                                                                                          | .. .. S. 45 E. . .                                                          | 45           | 76                                                                                                                              | .. .. North " . .           | 90           |
| 26                                                                                                          | .. .. S. 10 E. . .                                                          | 80           | 77                                                                                                                              | .. .. N. 20 W. (clump of 3) | 110          |
| 27                                                                                                          | .. .. S. 45 E. . .                                                          | 45           | 78                                                                                                                              | .. .. N. 35 W. . .          | 125          |
| 28                                                                                                          | .. .. S. 20 E. . .                                                          | 70           | 79                                                                                                                              | .. .. N. 30 W. . .          | 120          |
| 29                                                                                                          | .. .. S. 60 E. . .                                                          | 30           | 80                                                                                                                              | .. .. N. 10 W. . .          | 100          |
| 30                                                                                                          | .. .. S. 60 E. . .                                                          | 30           | 81                                                                                                                              | .. .. N. 65 E. . .          | 25           |
| 31                                                                                                          | .. .. East. . . .                                                           | 00           | 82                                                                                                                              | .. .. N. 70 E. . .          | 20           |
| 32                                                                                                          | .. .. S. 75 E. . .                                                          | 15           | Mean direction, 33 cases, N. 24° E.<br>Mean inclination, 66 degrees.                                                            |                             |              |
| 33                                                                                                          | .. .. S. 56 E. (Included as<br>belonging by its inclination to this table.) | 34           | TABLE V.<br>Right side of track, from line <i>a a</i> to<br>outward limit of prostration—5 ch.                                  |                             |              |
| 35                                                                                                          | .. .. East . . . .                                                          | 00           | 63                                                                                                                              | Tree lies N. 65° E. . .     | 25           |
| Mean direction, 18 cases, S. 37° E.<br>Mean inclination inward, 53 deg.                                     |                                                                             |              | 83                                                                                                                              | .. .. N. 45 E. . .          | 45           |
| TABLE III.<br>Right side of apparent axis from<br>line <i>c c</i> to <i>W E</i> —3 chains.                  |                                                                             |              | 84                                                                                                                              | .. .. N. 40 E. . .          | 50           |
| 21                                                                                                          | Tree lies N. 56° E. . .                                                     | 34           | <i>e</i>                                                                                                                        | .. .. N. 55 E. . .          | 35           |
| 22                                                                                                          | .. .. N. 60 E. . .                                                          | 30           | 85                                                                                                                              | .. .. N. 70 E. . .          | 20           |
| 34                                                                                                          | .. .. N. 80 E. (Included as<br>belonging by its inclination to this table.) | 10           | 86                                                                                                                              | .. .. N. 23 E. . .          | 67           |
| 36                                                                                                          | .. .. N. 85 E. . .                                                          | 5            | 87                                                                                                                              | .. .. N. 31 E. . .          | 59           |
| 37                                                                                                          | .. .. East (two) . .                                                        | 0            | 88                                                                                                                              | .. .. N. 20 E. . .          | 70           |
| ..                                                                                                          | .. .. East . . . .                                                          | 0            | 89                                                                                                                              | .. .. N. 22 E. . .          | 68           |
| 38                                                                                                          | .. .. East . . . .                                                          | 0            | 90                                                                                                                              | .. .. N. 10 E. . .          | 80           |
| 39                                                                                                          | .. .. N. 30 E. . .                                                          | 60           | 91                                                                                                                              | .. .. N. 55 E. . .          | 35           |
| 40                                                                                                          | .. .. N. 70 E. . .                                                          | 20           | 92                                                                                                                              | .. .. N. 70 E. . .          | 20           |
| 41                                                                                                          | .. .. N. 55 E. . .                                                          | 35           | 93                                                                                                                              | .. .. N. 55 E. . .          | 35           |
| 42                                                                                                          | .. .. N. 50 E. . .                                                          | 40           | 94                                                                                                                              | .. .. N. 63 E. . .          | 22           |
| 43                                                                                                          | .. .. N. 78 E. . .                                                          | 12           | 95                                                                                                                              | .. .. N. 25 E. . .          | 65           |
| 44                                                                                                          | .. .. N. 45 E. . .                                                          | 45           | Mean direction, 15 cases, N. 44° E. Mean in-<br>clination inward from course of tornado, 46°.                                   |                             |              |
| 45                                                                                                          | .. .. N. 45 E. . .                                                          | 45           | Mean direction of all the prostrations on<br>left of axis, 34 cases, S. 5° W.—being 3°<br>backward, or 93° inward and backward. |                             |              |
| 46                                                                                                          | .. .. N. 25 E. . .                                                          | 65           | Mean direction on right of axis, 65 cases<br>N. 33° E.—being 52° inward from course.                                            |                             |              |
| 47                                                                                                          | .. .. N. 35 E. . .                                                          | 55           | Difference of mean inclination on the<br>two sides, 41 degrees.                                                                 |                             |              |
| 48                                                                                                          | .. .. N. 40 E. . .                                                          | 50           | Difference of opposite marginal sections<br>(Tables I and V) 92 degrees.                                                        |                             |              |
| Mean direction, 17 cases, N. 60° E.<br>Mean inclination inward, 30 deg.                                     |                                                                             |              |                                                                                                                                 |                             |              |



## NEW-BRUNSWICK TORNADO.

(Plate I.)



*Sketch of the Prostrations found on a section of the Track of the Tornado of June 19, 1835, on the bank of the Raritan, opposite the City of New Brunswick, in the State of New-Jersey.*

**EXPLANATIONS.**—The east bank of the river is here covered with a belt of wood; the latter having a very irregular outline on the east, where it is bounded by a clear field. The line *c c* represents the apparent course of the axis of the tornado: W. west, E. east. The large dots on the several figures show the root ends of the trees, which were chiefly a species of cedar. In all these cases of prostration, part of the roots were still fast in the ground. Course of the tornado east. The approximate positions of the several trees are in many cases slightly changed in the sketch, for the purpose of a distinct exhibition of each.

*Note.*—This bank of the river is intersected by small ravines with wooded margins, one of which is nearly opposite to chain 5, and another is near chain 13, and which cause most of the irregularity in the wooded outline.



8. It follows, in like manner, that on that side of a whirlwind in which the rotary motion coincides with the progressive movement, the prostrating power will not only be increased in its intensity, but will also be effective over a wider space; and that few, if any, of the prostrated bodies will be found to have been thrown backward.

In the case before us, as may be seen in the sketch, the prostrations are found to extend on the southern or right side of the apparent axis to a distance nearly twice as great as on the left side. The same general result has also been noticed in the tracks of other tornadoes which I have examined.

The facts here considered are too important to be overlooked, and seem fully to establish both the whirling action and the course of rotation.

9. If a rotative action be exhibited, the mean directions of all the prostrations, on each of the two opposite sides, will differ greatly in their respective inclinations to the line of progress, and the mean direction of those on the reverse side will be found more backward than on the opposite side, where the rotative course coincides with the progressive action.

In the case before us, the mean direction of all the prostrations on the right side of the track is found to incline 52 degrees inward from the line of progress. The course of the tornado is here taken to be east; although for the last half mile its course had been a little north of east. On the left side, the mean direction is found to be S. 3° W., or 93 degrees inward and backward; a difference in the mean inclination from the course on the two sides of 41 degrees.\*

If we now take the indications afforded by the two exterior portions of the track, to the width of five chains on each side, where the effects are more distinctive in their character, we find on the right side a mean inward inclination of 46 degrees, the mean direction being N. 44° E.; while on the left side of the track the mean inclination is not only inward but 48 degrees backward, the mean direction on this side being S. 48° W. We have thus a mean difference in the inclination of the fallen trees, on the two exterior portions of the track, of no less than 92 degrees.

These indications seem conclusive, also, in favour of the whirling action in the direction from right to left.

10. Although of less importance, it should be mentioned that the diminished action of the tornado which is commonly observed on the hillsides and summits over which it passes, and the greatly increased action in the bottoms of the valleys, and even in deep ravines, afford

\* The inclinations of the fallen trees from the course, on both sides of the axis, are reckoned inward and backward.

a strong argument against ascribing the effects to the ascent of a non-whirling rarefied column; as the latter, it would seem, must act with greater force on the hillsides and summits than in the bottoms of valleys. The general correctness of the observation above stated cannot justly be questioned.

11. The sudden and extraordinary diminution of the atmospheric pressure which is said to take place at the points successively passed over by a tornado, causing the doors and windows of buildings to burst outwards, seems to afford strong confirmation of a violent whirling motion; for an effect of this kind is necessarily due to the centrifugal and upward force of the vorticular action in the interior portion of the whirlwind. There are no other means known by which such an abstraction of pressure can be effected in the open air. An increase of calorific elasticity, if such were produced, either generally or locally, would not greatly disturb the equilibrium of pressure, being resisted by the surrounding and incumbent weight of the entire atmosphere. Besides, the immediate effect of such increased elasticity might rather be to burst *inward* the windows and doors of buildings exposed to its action.

Some of the more important indications mentioned above appear also from an examination of Prof. Bache's observations; although the latter are not definitely located by him, as regards the extreme borders of the track. Thus, in Fig. 7 of Professor Bache's paper, assuming the course of the tornado to be east, and rejecting a few observations near the centre, to avoid error, we find in twenty observations on the right side of the track, a mean inward inclination of 64 degrees; and for nine observations on the left side, a mean inclination, reckoned inward and backward from the course, of 104 degrees, being 14 degrees backward.

It is stated by Prof. Bache, "that the trees lying perpendicular to the track of the storm, are not those furthest from the centre of that track." This generalization accords with my own observations; but can hardly be reconciled with an inward non-whirling motion in the tornado.

It may appear to some, that in the case of a whirlwind the greater portion of the prostrations on the reverse side of the axis should be found in a backward direction; and so they would undoubtedly be found, were it not for the inward and the progressive action. But the force is here so far lessened by the reverse action above noticed, that in most cases only a small portion of the trees exposed will be thus prostrated; while the greatest force of the whirlwind, on this side, is felt near its last or closing portion and towards the apparent axis, where the inward, together with the rotative and progressive

forces, seem to combine their influence in the closing rush towards the heart of the receding vortex. This appears to account for the nearly opposite directions of prostration found on this side, and it is apparently by this more violent closing action, that many trees which were first overthrown in a direction nearly across the centre of the path, were again moved from their position, and swept onward nearly in the course of the tornado. It is proper to remark here, that an attentive examination of these effects has served to convince me that on the right and more central portions of the track the prostrations for the most part take place either at the outset or under the middle portions of the whirlwind; while on the left or reverse side, up to the line of the apparent axis, and even across the latter, they occur chiefly under the closing action of the whirl, as above described. The violent effects of this central and closing action are more clearly seen as we advance from the left-hand margin towards the centre or apparent axis of the path.

From the causes to which I have just alluded, the effects are usually more violent on and near the line passed over by the axis, than in other portions of the track. This line of greatest violence is found to coincide nearly with the line which separates the inwardly inclined prostrations of the two opposite sides of the track.\* The latter line or apparent axis of the track is sometimes called the line of convergence, and is indicated on the figure by the line and arrow *c c*. Along this line, from the causes just mentioned, aided also by the elevating forces about the axis, many of the trees are swept onward, and left with their tops in a direction nearly parallel to the course of the tornado; forming an apparent, but not a just, exception, to the more lateral direction which pertains to most of the trees prostrated by the onset of the whirlwind, near the central portions of the track. Indeed, the central or closing violence of the advancing whirl is here so great, that the trees are not unfrequently torn out of the ground and carried onward to considerable distances.

It is proper to state here, that in the tracks of all the tornadoes which I have had opportunity to examine, and in some, at least, of those examined by others, the course of rotation has been found the same as in the case before us.†

In order to make a just and satisfactory examination of the effects of a tornado, it appears necessary to select portions of the track where the extension of wood or single trees, on each side, is found sufficient

\* The line of greatest violence, for the most part, is found somewhat to the right of the line of convergence.

† As in the tornado which passed through Alleghany county, New York, July 25th, 1838; described by Mr. Gaylord in the *American Journal of Science*, vol. xxxvii, p. 92.



to mark clearly the exterior limits of the prostrating power, and where the effects on both sides of the axis are also clearly developed. Our next care should be to ascertain, as near as may be practicable, the line which separates the opposite convergence of the two sides, noticed above as the axis or line of convergence. We should then determine the general direction of this line and of the track at the place examined; which being done, we may proceed to measure the distance to which the prostrations are extended on each side, and then carefully to take the position and direction of prostration of each and of all of the fallen bodies, noting with care, also, any other phenomena which may serve to aid our inquiries. We may thus obtain valuable materials for future analysis; and this course of investigation, if faithfully pursued, will, it is believed, remove all reasonable doubt of the rotative action of these tornadoes. An examination of their probable origin, and the causes of their enduring activity and violence, belongs not to the present occasion.

*New York, 5th February, 1841.*

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### **Mechanics' Register.**

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LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1840.

*With Remarks and Exemplifications by the Editor.*

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1. For an improved method of taking *Daguerrotype Likenesses by means of a Mirror*; Alex. S. Wolcott, city of New York, May 8.  
(See specification.)
2. For an improvement in the *Stop-Cock for Water and Gas Pipes*; James Robertson, city of New York, May 8.

This stop-cock has a sliding valve resembling others which have been used, and it is so constructed as to admit of the easy sliding of the valve, and, at the same time, of its being pressed against its seat after it is in place; and also to admit of the cleansing of the chamber from any dirt that may accumulate within it.

The box is constructed as usual, with two side pieces, which fit into the pipe, and a top piece in which works the screw, which moves the valve up and down. The valve has three projections, one at top, with a vertical slot in which plays a projection from the nut that fits on the screw, and one ear at each side. The valve is pressed to its seat by what the patentee calls a "wedge," which is attached at top to the nut, and works up and down with it—it branches off, and each branch acts upon two projections on the back of the valve, one towards each edge. Each branch, at the edge, is provided with a projection which slides against the side of the box opposite to the valve seat. When the screw is turned with the view of shutting the



valve, the two branches of the wedge are resting on the top of the projections on the back of the valve plate, and thus as the wedge descends it carries the valve with it, without pressing it against its seat; but when the valve has reached the bottom, the two projections on the back of the branches of the wedge have reached two notches in the side plate of the box, which permit the branches of the wedge to slide over the projections on the back of the valve, and thus wedge it to its seat—the slot in the piece which projects from the upper part of the valve allowing the wedge to descend after the valve has reached the bottom. The bottom of the chamber is provided with a seat for a conical valve, which works up and down by means of a lever passing through the casing for that purpose—when the valve is lifted up the dirt passes out.

The claim is to “making the valve fit more firmly in its seat by means of the independent wedge, constructed and operating as described.” And also to the “mode of cleansing the chamber from any dirt that may accumulate in it, by means of the escape valve, as described.”

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3. For an improved *Tailor's Measure for taking measure for coats*; Richard Dame, Hanover, Grafton county, New Hampshire, May 8.

This is for improvements in what is generally known as the “Tailor's measuring square,” and consists first of attaching an additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, at that end of it which forms the angle; and secondly, in providing the branches with sliding hinges, one half of each hinge being made to slide upon the branches, and the other having curved hooks, the points of which, in opening the hinges, catch the coat on the person to be measured, and then pass through holes in the other leaf, thus securing the instrument to the body—the claim is to the “attaching of the additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, by means of the hinge, and combining the branches and the sliding hinges for attaching said branches, as set forth.”

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4. For a new mode of *Making Wigs*; Francis Bourgnnet, city of New York, May 8.

Not being well versed in the art of making wigs, we will merely quote that part of the specification in which the inventor states the nature of his invention, and to this we will append his claim. “The nature of my invention consists in an apparatus whereby the pressure of the metallic spring may be varied at the will of the wearer.” “What I claim as my invention, and desire to secure by letters patent, is the construction of the metallic wig with an additional transverse piece or spring, tempered soft, and flexible, so that it may be bent to any degree the wearer pleases, and of sufficient thickness to control the elastic spring, and keep it in the position to which it has been bent. I also claim the combination of the side plates for distributing the pressure with the transverse springs. Lastly, I claim in combination

with the above, the arch spring and oblique springs, the whole being constructed, and operating as herein described."

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5. For an improvement in the *Horse Power for driving machinery*; George Strenge, and Jacob Rohrer, Manhiem township, Lancaster county, Pennsylvania, May 8.

This is for an improvement in that kind of horse power in which the power is applied, by causing the horse to walk in a circle, and to draw by means of a lever or sweep, attached to a vertical shaft; and it consists in the peculiar manner in which the levers or sweeps are attached to the main driving wheel. The patentees observe that "sweeps of this description have heretofore been fastened to the main shaft in such manner as not to allow of their having any vertical play, in consequence of which, a considerable portion of the power of the horse or horses has been expended without the production of any useful effect, and has, in fact, been productive of injury, by racking the machine." In this machine the sweeps pass through staples attached to the main wheel, which staples are so formed as to confine the sweeps laterally, whilst they are allowed to play vertically. The inner ends of the sweeps are received within mortises in the upper end of the shaft, and there are springs on the upper and lower sides of the rear ends of the sweeps, which bear respectively upon the main driving wheel and upon the upper part of the staples. The upper springs are provided with an off-set to operate as a latch in confining the sweeps in place.

The claim is to the "allowing of a vertical play to the sweeps or levers, by causing springs to act upon their upper and lower sides, in the manner described."

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6. For improved *Brakes for Railroad Cars*; Matthew W. King, city of New York, May 8.

This brake is so constructed as to act against the insides of the two rails at the same time, there being two levers, each provided with a roller at its outer end. These levers are placed nearly at right angles to each other, and work on a stud suspended from the bottom of the car. Two connecting rods are jointed to each of these levers, and these connect them with a screw passing through a nut, so that when the said screw is turned one way, the rollers on the ends of the levers will be pressed against the insides of the rails, and when turned the other way, will be relieved from them. The screw is turned by means of a pinion attached to its outer end worked by a cog wheel, which can be actuated by the tender.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the compound lever brake, combined and arranged as herein described."

7. For an improvement in the method of *Teaching the art of writing*; called "the transparent writing guide;" William Davidson, city of New York, May 8.

The patentee says, "the nature of this invention consists in preparing the surface of a glass fixed in a frame, under which the copy to be imitated is placed, by rubbing over its surface a certain composition, which forms a surface that will receive an ink of a peculiar kind, transferred thereto by a pen of a peculiar construction, which prevents its too rapid flow, and consequent spreading. The copy to be imitated is prepared on paper of a yellowish hue, with ink made of Kremnitz *white* mixed with water, and a small quantity of gum Arabic, and placed under the glass."

The pen made use of is constructed in the following manner. "On the inside of a common steel pen is inserted a concave piece of steel having the same curvature with the pen, but not extending as far as its point by about a quarter of an inch. This piece of steel is to be cut off square at the end, and is to be so arranged in the pen as to retain the ink, while it does not interfere with its spring and proper shape; as it is intended that when the point of the pen is pressed upon the glass it shall yield and recede from the aforesaid piece of steel, which retains its original position, and thus the communication is cut off, and the ink is prevented from flowing too fast upon the glass. The surface of the glass must first be prepared for receiving the ink in the following manner. A composition of hard soap and English scouring sand, is formed into a cake of convenient size, and with this the surface of the glass is to be well rubbed; it will then retain the ink."

"What I claim as my invention, is the method of preparing the surface of the glass under which the copy to be imitated is placed, and on which the writing is performed, by rubbing it with a cake composed of hard soap and English scouring sand, as before described."

We are apprehensive that the patentee of the above invention has learned, since obtaining the above patent, that teachers of writing are a very obstinate class of men, preferring the old mode of teaching by pen, ink, and paper, to that by the aid of hard soap and *English* scouring sand.

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8. For an improvement in the *Tub Water Wheel*; Abijah Woodward, Athol, Worcester county, Massachusetts, May 8.

The claim appended to the specification of this patent, will give a sufficiently clear idea of the invention; viz: "What I claim as constituting my invention, is the enlarging of the lower end of the shaft of such a wheel by surrounding the same with a drum; upon which drum I place two rows of buckets in addition to, and in combination with the row of buckets used in the ordinary tub wheel; the whole being constructed and operating substantially as herein set forth."



9. For an improvement in the *Thrashing Machine*; Jesse Lincoln, Uniontown, Fayette county, Pennsylvania, May 8.

This patent is taken for a mode of carrying off the grain and straw from the machine after it has been thrashed, and thus separating them from each other. An endless belt of woven wire passes around a roller at each end of a frame placed immediately in front of that part of the thrasher at which the straw and grain are discharged, and as this endless screen moves around the rollers, it receives a "shaking" motion by the revolutions of what the patentee calls a "flat roller." The claim is to the "combination of the 'flat roller' with the revolving screen, as described."

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10. For an improvement in the *Dredging Machine for Docks, Rivers, &c. &c.*; Oliver Allen, Norwich, New London county, Connecticut, May 8.

This is an improvement on the dredging machine invented by Elisha H. Holmes, for which he received a patent on the 18th of November, 1830, and which is noticed in this journal, vol. vii, page 167. The scoop, as usual, has a handle to it, which passes through a loop in a standard at the side of the boat or scow, and this is drawn forward, in scooping, by a rope or chain attached to a bale, which passes around pulleys on the end of two swinging levers projecting from a vertical shaft, and thence around two other pulleys to the capstan. A rope is attached to the scoop, where it is connected to the handle, and passes over a pulley at the top of a mast or high standard. By regulating the length of this rope, the point to which the scoop swings back to recommence its operation is also regulated. The patentee says that the "main object of his improvement is so to construct the machine as that the scoop by which the earth is to be raised shall be taken back by its own gravity to any desired point on the bottom of the river, dock, or other water, where the excavating is to be effected, instead of drawing it back by manual labour, as has usually been done." The claim is to the manner in which the scoop is governed and directed by the combined operation of the levers, and the rope or line passing over a pulley on the mast or standard.

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11. For improvements in the *Winnowing Machine*; Abel and Asahel Lomax, Clinton county, Ohio, May 8.

The blower of this fanning instrument is formed with spiral vanes revolving in a cylindrical case open at one end to the atmosphere, the other being adapted to the shoe placed at the end of it. The shoe rocks upon a pivot and journal at the bottom, so that it has greater play at top than at the bottom. The patentees claim, "first the adapting of one end of the cylinder to the shoe, and thus having the air to pass from its end directly into the shoe. And secondly, the mode of arranging the shoe, by which greater motion is communicated to the upper than the lower part of it."



12. For an improvement in the *Garden Hoe*; Charles S. Horner, Boston, Massachusetts, May 8.

The claim appended to this specification explains the nature of the improvement; it is as follows, viz:

"What I claim is the mode herein described, of connecting the hoe plate and shank by forming the latter with a square head and riveting it to the outside of the blade, the shank having been passed through it, and passing an iron collar over the shank on the inside of the hoe plate, in the manner described, so as to confine the plate between said collar and the square head on the outside of it, by means of which arrangement I am enabled to give not only greater strength to the blade of the hoe, but to make the instrument more durable than hitherto constructed."

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13. For improvements in the manner of *Constructing Railroads*; which improvements are applicable to common roads and streets; William Russell, New York city, May 8.

The patentee says, "my invention consists in a new and improved manner of preparing and laying wooden blocks, either on the horse tracks for railroads, or on common roads and streets; and also in a new and improved mode of preparing the string pieces for railways."

"The track upon which horses are to travel upon railroads, and upon which horses and carriages are to pass on common roads and streets, I pave with blocks of wood, but these blocks I form, arrange, and sustain in a new and peculiar manner. Along the road, whether it be a railroad, common road, or street, I lay string pieces in such manner as to form and constitute an abutment on each side of the portion which is to be paved with wood, and these, as well as the wood pavement, I lay upon hemlock or other suitable plank, placed in double thicknesses, crossing each other diagonally, after having first duly graded and prepared the ground for their reception. When a railway is to be formed, I lay plate rails along the string pieces, and these plate rails I confine down by means of bolts and keys." "The paving blocks are cut from scantling, diagonally, so that the grain of the wood is inclined instead of standing vertically, and the inside of the string pieces are inclined to correspond with the inclination of the blocks. Two rows of blocks incline one way, and the next two, the opposite way. The claim is to "the manner of forming the track or road, by the combination of the string pieces with sloping sides, and the wooden blocks cut from scantling, adapted to the said sloping sides, and resting on a foundation of boards or plank, as described."

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14. For an improvement in the *Life Preserver*; Ralph Bulkley, New York city, May 8.

Two hollow metallic tubes are attached to a belt, which belt buckles round the body, so as to bring one of the tubes under each arm—a strap attached to the belt passes over each shoulder, and one hangs

down from each side, with a loop at the bottom to answer the purpose of a stirrup, so as to relieve the arms or shoulders of a portion of the weight. The claim is to the "combination of the air-tight tubes with the belt, in the manner, and for the purpose described."

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15. For a mode of *Converting the Mattresses of Ships, Boats, &c., into Life Preservers*; Henry Blake Bourne, New York city, May 8. (See specification.)

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16. For an improvement in the *Sparger used in the process of Brewing*; H. Jones Brooke, and Francis B. Longmire, city of Philadelphia, May 8.

The patentees say, "the apparatus or instrument, denominated a sparger, is employed for the purpose of distributing water upon the malt contained in the mashing tub, or tun, in order to extract the saccharine matter in the preparing of the wort. As heretofore made, the sparger has been made to revolve near the surface of the mash tub, by the aid of gearing from a steam engine or other motive power; it has been constructed at considerable expense, and from its complexity has been subject to wear, and get out of order. In our sparger, these difficulties are removed by rendering it self-acting, by causing it to operate upon the principle of 'Barker's mill.'" From the middle of the tub rises a vertical shaft, on which revolves the sparger, which consists of a receiver, or funnel, from which the water runs down two tubes into a receptacle at the bottom, and from this receptacle branch out four hollow arms, with apertures through which the water flows, actuating the apparatus by re-action. The claim is to the manner in which the patentees have combined the re-acting apparatus with the mashing tub, as described.

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17. For a mode of *Stopping leaks in Hose*; Ralph Bulkley, New York city, May 8.

This patent is taken for a mode of stopping breaches in leather hose, whether small or large. Small breaches, or holes, are to be closed by a conical screw plug with a flat head. The point of the screw is to be inserted in the aperture, which, by screwing, is gradually enlarged, embracing the screw until the water is prevented from flowing out. But if the aperture be a slit passing lengthwise, it may be temporarily repaired for use by two corresponding plates of metal, the one to be placed inside of the aperture, and of sufficient length to cover it, there being a corresponding plate upon the outside of the aperture; the two plates are to be drawn together by screws, previously fitted to them, thus firmly binding the edges of the leather between the said plates of metal. If the aperture be so large, or of a description that it cannot be secured by such screws or plates, then a section of metal, or other description of pipe or tube, of suitable dimensions, may be inserted within the defective part, and the apparatus denominated "*breach clogs*," is to be applied thereto; but if the breach

required to be stopped, be not, in itself, large enough to admit of the application of the "breach clogs," the water hose may be severed by cutting it entirely across, or incisions of suitable extent may be made for the convenient and necessary application of the said apparatus. The claim is to the "mode of repairing lateral breaches in hose by means of screws, as set forth. Also of repairing larger breaches in the same by means of metallic plates and flexible tubes, inserted in hose, constructed and secured in the manner described."

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18. For improvements in the *Fire Escape*; William P. Withey, Hartford, Connecticut, May 12.

The patentee says, "the nature of my invention consists in a system of ladders sliding one within another, with a platform affixed on the top of the uppermost one. The ladders are supported by frame work erected on a circular, revolving base, to which the footing of the ladder is hinged. The ladder is elevated to any angle with the horizon by means of rigging of cord or chains, the whole being supported on an oblong horizontal platform, which is mounted on wheels, to facilitate transportation from place to place." "I do not claim as my invention the ladders, windlasses, pulleys, or any of the above described parts unconnectedly considered—nor do I claim as my invention any of the means by which the several parts are connected together. But what I claim as my invention, and desire to secure by letters patent, is the hinging of the railed platform to the top of the ladder, and rendering it capable of being adjusted to a horizontal position, whatever may be the inclination of the ladder, by means of the toothed segments, the whole being constructed and operating in the manner described."

The segments mentioned in the above claim are attached to the ladder, near the top of its upper section, and pass through holes in the platform, which is hinged to the top of the same section of the ladder; and, by means of pinions on a crank shaft working in standards attached to the said platform, the platform is made to assume any required position.

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19. For an improved machine for *Hulling Grain*; James McGregor, Saratoga, New York, May 12.

The first paragraph of the specification gives so clear an idea of the principle of this machine, that we shall merely quote it, together with the claim. "My grain and seed rubbing machine, consists, in general, of a circular disk affixed to a vertical shaft, and made to revolve within a stationary cylindrical case or drum, adapted thereto. Upon each side, and upon the edge of said disk, and upon the interior of each head, and on the rim of the drum, there are placed strips of metal, usually denominated flights, which have such a direction given to them as shall carry the grain from near the centre of the upper side of the disk, where it is fed in, towards its periphery; and then on the under side, from the periphery towards the centre, whence it is delivered; the grain or seed, during its passage, being kept under



pressure by the direction given to the flights, and also by means of a valve borne up against the aperture through which the grain or seed is to escape; a spring or weighted lever being applied thereto."

"What I claim as my invention, and desire to secure by letters patent, in the above described machine, is the manner in which I have combined and arranged the revolving disk, and the hollow drum or cylinder, with flights, or projecting pieces thereon, affixed in such a way as to carry the grain or seed, under considerable pressure, towards the periphery, on the upper side, and towards the centre on the under side of the revolving disk. I also claim in combination therewith, the valve bearing against the delivery opening, for the purpose of increasing the pressure to any desired extent."

20. For an improvement in the *Franklin Cooking Stove*; J. Houghton, Ogden, Monroe county, New York, May 12.

The jambs, front plate, and top plate with two boiler holes, of the open Franklin cooking stove, are united together, and so arranged that they can be let down so as to bring the boiler holes directly over and near to the fire; for this purpose the jambs slide in holes made in the bottom plate, and a chain attached to the top winds around a shaft passing through the pipe, and having a crank attached to it. The front plate is made with openings like the front of a grate, so that when the front of the stove, top, and jambs, united together, are let down, the front will answer the purpose of the front of a grate. The flues are adapted to this arrangement. The claim is to "making the jambs of the stove, or Franklin, to lower through the apron of the same, so as to bring the boilers that are above the jambs immediately over the fire."

21. For a machine for *Hulling Rice, Barley, Clover Seed, &c.*; Daniel Tomlinson, Brookfield, Fairfield county, Connecticut, May 12.

This machine consists of a horizontal case, and a cylinder capable of revolving therein. The end of the case which receives the grain is provided with a hopper, and around the opening which communicates with the hopper there are about six oblique wings. Within the case there are teeth arranged in rows; the first three rows of these are about one inch wide, thick in the middle, and tapering towards the edges—they project from the surface about half an inch, and are placed with their flattened surfaces at an angle of forty-five degrees with the longitudinal axis of the cylinder. The rest of the teeth are cylindrical. The opening at the discharging end of the case is provided with a sliding valve to regulate the discharge of the grain. "For most purposes," the patentee says, "the case is perforated with oblong apertures, say half an inch long, and one-twentieth of an inch wide, for the escape of the dust and dirt, but they are not to be so large as to suffer the grain to pass through." The teeth on the cylinder are arranged in the same manner as those within the case, excepting that the rows on the former work between those of the latter, and the cylinder at the receiving end instead of being provided with wings,



has inclined notches, to give free entrance to the grain. The claim is as follows. "What I claim as my invention, and desire to secure by letters patent, is the before described mode of producing any desirable amount of pressure on the materials to be hulled or cleaned, and continuing the same through the whole length of the cylinder, by the combined operation of the oblique teeth, the round teeth, and the sliding gate or issue—effected continually during the operation of the machine."

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22. For a mode of *Fastening Bedsteads*; William H. Sabin, New Milford, Susquehanna county, Pennsylvania, May 12.

This patent is for an improvement on the dovetail fastener, in which a dovetailed projection attached to the post fits into a corresponding recess in the end of the rail.

Dovetailed projections are attached to each post, one for each rail, by means of a ferule, or a segment of a ferule, which is let in and fastened to the post; and the dovetailed recess is made in the end of a ferule fitted to the end of the post. The patentee says, "I do not claim to be the inventor of dovetail fastenings for connecting the posts and rails of bedsteads. But what I do claim, is my improved mode of forming and affixing them by a cylindrical ferule, or segment of a ferule, to the post, and by a ferule to the rails, the end of which ferule is hollowed to adapt it to the post."

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23. For an improved *Sofa for Invalids*; Martin Engel, Borough of Easton, Northampton county, Pennsylvania, May 12.

The arrangement of means by which the sofa can be changed into a chair to recline in any position for the accommodation of an invalid could not be made very clear without drawings, and we will therefore merely state that the bottom of the sofa is made in sections hinged to one another, the middle part being permanent and one end hinged to it so as to be elevated for the back, the upper end of this being made in two parts, is hinged so as to fall back a little for the head. The other end is hinged to the permanent part so as to let the legs down, the lower end of this section being so hinged as to make the foot board. The upper section for the back is raised by straps attached to circular arms on the bottom passing over a roller running from front to back under the arm of the sofa, and winding on a windlass below it, and the leg and foot board at the other end is let down and supported by straps winding around a windlass within the other arm piece. The permanent part of the bottom has a hole in it with a cover for the convenience of a patient who is unable to leave the couch.

The patentee says, "having thus fully described the manner in which I construct and arrange the respective parts of my sofa for invalids, and shown the use of those parts respectively, I do declare that I do not claim the so constructing of a sofa, or couch, as that the head and foot parts thereof may be raised or lowered to adapt it to the use of invalids, but what I do claim as constituting my invention.

and desire to secure by letters patent, is the peculiar and novel manner in which these objects are effected by me so as to render it more manageable and convenient than those heretofore constructed. That is to say, I claim the manner in which I have combined the windlass with the rising frame and the jointed arm in the head part, not intending to claim either of those parts separately but only in their entire combination as herein set forth; I in like manner claim the combination of the respective parts which constitute the lowering and elevating portions of the foot end divided into two parts widthwise, and connected and operating as a whole in the manner set forth."

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24. For an improved mode of making and affixing the *Ears and Bails, or Handles, of Pails, Kettles, Buckets, &c.*; John F. Phelps, city of New York, May 12.

The following extract from the specification will be sufficient to convey a clear idea of this improvement, viz: "In the ordinary method of affixing the ears and handles, or bails, of buckets, or other vessels, the ears are made to project above the rims of said buckets, or other vessels, and the wires, or round rods, of which the bails are formed are usually made to hook into said ears with their ends turned outwards. In my improved mode of constructing them the ears are placed entirely below the rim of the vessel and the ends of the bails are turned inwards, and are received and turned round within a concavity formed in the ear or in the vessel for that purpose. These ears may be riveted, screwed, or soldered, to the vessel according to circumstances, they may also be varied in form. What I claim as my invention, and desire to secure by letters patent, is the so constructing and affixing the ears and bails of buckets, or other vessels, of wood, or of metal, as that the hooks of the bails bent inwards shall be received and turn within a cavity prepared to receive them on the under side of the ears as described, the latter being attached so as to stand below the rims of the vessels to which they are affixed. I do not claim the mere turning of the hooks inwards, this having been before done, but I claim only the combination of the hooks and ears as above set forth."

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25. For improvements in *Dry Docks*; John S. Gilbert, city of New York, May 12.  
(See specification.)
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26. For a method of *Preventing Explosions in Steam Boilers*; James Reid, Pawtucket, Providence county, Rhode Island, May 19.

The patentee says that "the object of his invention is to prevent the accumulation of the superabundance of caloric in the steam to such a degree as to produce injury or an explosion." And this he effects, or aims to effect, by means of an apparatus connected with the safety valve. A coiled tube closed at top and open at bottom is placed near the top of the boiler, its open end communicates with a

cistern containing mercury, and from near the bottom of this cistern rises a pipe which passes up through the top of it and opens into a tight cylinder provided with a float. The stem of the float is so connected with the lever of the safety valve, and when the float is raised to a certain height it is to open said valve. The tube first mentioned is filled with water, or gas, (the patentee prefers the former,) which is heated by the steam in the upper part of the boiler, thus generating steam in the tube which will press upon the top of the mercury contained in the cistern, and force it to raise up the pipe against the bottom of the float contained in the cylinder, and as this float rises it is to open the safety valve, by its connexion with the lever thereof. The claim is to the coiled tube, mercurial cistern, pipe, cylinder and float, in combination with the safety valve.

The objections which might be urged against the said device are of such a character as, we think, would fully show its inadequacy to the effecting of the object proposed; these we have neither time nor space to urge, nor will they be necessary to those who possess practical, and some scientific, knowledge.

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27. For an improved *Machine for Cleaning Grain*; Samuel Spangler, Stony Creek Township, Somerset county, Pennsylvania, May 19.

A blower similar to that used in the common wheat fan is made use of in this machine, and from the spout thereof arises a vertical trunk, or case, in which revolve three sets of fans or beaters one above the other, worked by bands passing over pullies on their shafts. Two sides of this case are perforated for the escape of dust, and an inclined, perforated plate is placed across the spout of the blower. The grain is fed in through an opening at the top of the case and passes out through an opening at the bottom.

The claim is to the fans in the case, as described, they being arranged one over the other in a perforated case so that they shall act both as beaters and fans in combination with the fan blower.

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28. For improvements in the *Floating Dry Dock*; William Thomas, St. Louis, Missouri, May 19.

This patent is for improvements on the floating dry docks noticed in the fourteenth volume of this Journal, page 232, and in the twenty-second volume, page 239, to the first of which the reader is referred for a description of its general principle, as also to page 336 of volume one, third series. At each end of each float a trunk rises vertically, divided by partitions into a pump well and ballast cistern. Each float is divided into separate chambers by tight bulk heads, and all the chambers are connected with the pump well by means of pipes governed by cocks and valves. The ballast cistern also communicates with the pump well by a valve. The patentee says, "the operation of this dock is by letting water into the pump well at each end of each float, by means of a cock turned by an iron rod which extends to the top of the trunk and from the wells into the several chambers through the several pipes, which pipes are opened and shut by rods



extending to the top of the trunk, and blocks and wooden cocks; and by pumping from the wells to the ballast cisterns the dock gradually sinks to the required depth, to admit the boat, or vessel, to pass free over the blocking, previously arranged to suit her bottom; the water is then shut off; the boat, or vessel, being placed and secured in her proper position, the pumping is commenced and continued until the deck of the dock is raised two or three inches above the water. During the process of sinking or raising the dock, the water is so regulated by letting it into the wells, and from them to the chambers, and by pumping into or discharging from the ballast cisterns, as to preserve an equilibrium at all times.

“What I claim as my invention, and desire to secure by letters patent, is the employment of the ballast cisterns in combination with the floats in the manner described. I also claim the making of the bulk heads which separate the chambers water-tight, so as to prevent the water from passing from one chamber to another except through the pipes governed by cocks as described. I also claim the mode of connecting the several chambers and the wells by means of water and air pipes governed by cocks, valves, or gates, for the purpose and in the manner described.”

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29. For an improvement in *Pumps*; Lebbeus Caswell, Harrison, Cumberland county, Maine, May 19.

The alleged improvement consists in making one or more slits in the body of the pump so that the piston rod and the piston can be connected together through said slit or slits, and the piston be worked by a piston rod outside of the pump bore. The patentee says, “what I claim as my invention, and desire to secure by letters patent, is the constructing of one or more slits in the lower part of the tube, or bore, of the pump, and connecting the piston rod with the movable piston by passing it through the same.”

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30. For an improvement in *Rifles and other Fire Arms*; James R. Thomas, Collinsworth, Talbot county, Georgia, May 19.

This patent was granted for an improvement on that kind of guns in which a separate chamber, removable from the barrel, is used. The separate chamber is made with a projection around the forward end of the bore, which fits into a recess in the barrel, the breech of the gun being made to receive the said chamber. Near the top of the back end, the chamber is provided with a hole which receives the end of a spring bolt to hold it in place. The spring bolt is drawn back by a projection from the tumbler which acts against an offset on the bolt, so that in bringing the hammer to the half cock the spring bolt is drawn out clear of the hole in the back of the chamber, and on cocking, the projection on the tumbler clears the offset on the bolt, and allows it to return by the action of a spiral spring coiled around it. A part of the lower part of the back of the chamber is beveled off so that in putting in the chamber the beveled part will force back the spring-



bolt until the chamber is in place. When the hammer is at half cock the chamber is forced up out of its place by a pin passing through a hole in the bottom of the case which receives the chamber; this pin is attached to the end of a spring screwed to the under side of the barrel.

The claim is in the following words, viz: "having thus fully described the manner in which I construct the detached chambers and the parts of the rifle, or gun, with which they are immediately connected, what I claim as constituting my invention, and desire to secure by letters patent, is the constructing a detached chamber in the form and manner herein described and represented, and the so constructing the breech of the gun as to receive the same, so that said chamber may be held in place by the projecting end passing into the rear end of the barrel, and by the spring bolt entering the mortise in the back part of said chamber, and so that it will be removed in the act of cocking the gun, or rifle, by the action of the spring and pin, as herein described. I do not make claim to either of these parts taken individually, but I do claim the manner in which I have combined them with each other so as to co-operate together substantially in the manner and for the purposes set forth."

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31. For an improvement in the construction of *Bee Houses*; Robert Martin, Fairfield, Columbiana county, Ohio, May 19.

The improvement claimed in this patent is applied to that kind of bee house in which a number of hives are placed one above the other, and consists simply in making the bottom of each hive of an inclined board which carries all the dirt to the bottom and through a hole in the floor through which it passes to the next hive below, where the same thing takes place until all the dirt is discharged at the bottom hive in the house. The claim is to "the mode of removing the dirt from the top to the bottom of the house by means of the apertures in the floors and drawers combined so as to form a passage from the top to the bottom of the hives."

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32. For an improvement in the *Thrashing Machine*; David Stafford, Syracuse, Onondaga county, New York, May 19.

This improvement consists simply in making the feed board in two parts, and having the part next to the cylinder hinged and borne up by springs so as to yield should any hard substances, such as sticks, or stones, enter the machine. The claim is to "the manner of constructing the feeding table, or drop apron, with one section to drop with the hinge, or pivot, and with the springs or other means underneath to sustain the same, as described; and the object of which is to prevent injury and fracture to the machine."

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33. For a mode of *Applying Water to Propel Mills*; William Baker, Utica, New York, May 19.

The engine employed in this mode of applying water power is similar in construction to the rotary steam engine and pump noticed in

the twenty-sixth volume of this Journal, page 164, to which the reader is referred for a description of it. From the bottom of the case in which the cylindrical segments, against which the water acts, revolve, a hollow trunk, or conductor, descends to the reservoir in which the water is discharged. In applying the water, the conductor and case, in which the segments revolve, are filled with water from the top to the bottom of the reservoir, the whole height not being greater than thirty-two feet, or equal to one atmosphere, and as the segments revolve against air-tight packing, the whole column of water is sustained by the atmospheric pressure, so that there is an atmospheric pressure upon the flanches, or valves, of the revolving cylinders, and by this pressure the segments are actuated. The water is only required to be of sufficient height to cover the segments and keep a constant supply of the fluid. The patentee says, "what I claim as my invention is the method herein described of applying the atmospheric pressure to propel a revolving engine, or machine, by placing a conductor for the passage of the water below such engine, or machine, by the descent of the water in which conductor the pressure of the atmosphere is brought to bear on the engine, or machine, corresponding to the height of the column of water below it. I also claim the combination of the revolving cylinders, and the enclosure in which they are placed, with the conductor below said engine."

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34. For constructing the *Valves, or Boxes, and Chambers of Pumps for Raising Water*; Joseph Evans, Lebanon, Warren county, Ohio, May 25.

The bore of the pump from the seat of the lower box upwards is larger than below, to admit of the introduction and withdrawal of the chamber and its appendages. The lower box consists of a rim and arms connecting it with a hub, or centre piece, provided with a loop by which the whole is removed. The lower part of the rim is tapered and covered with leather so as to fit water tight against that part of the bore on which it rests. The chamber is made of copper, and its inner diameter is equal to the inner diameter of the rim of the lower box, but towards the bottom it swells out so as to receive the box within it, and the two are united by screws. The upper part of the chamber swells out trumpet shaped to fit the bore of the pump where it is provided with a band of leather. The upper box consists of a cylindrical rim united to the centre piece by arms, and it is covered with a circular piece of leather which answers the double purpose of valve and packing—the piston rod screws into the centre piece and embraces the leather valve.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and connected the copper tube, forming the chamber of my pump, with the lower box, or valve, and seat thereof, as described, and for the purpose set forth. I also claim the manner in which I have constructed the upper box, or valve, and seat, that is to say, the causing the

leather disk, which constitutes the valve, not only to operate as a valve but also as a packing to the piston."

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35. For a machine for *Washing Clothes*; Sewall Benson, Waterville, Kennebeck county, Maine, May 25.

The clothes to be washed are attached to a fluted wash board made in two parts, the lower one fixed at the bottom of a frame, and the other sliding in grooves in the side pieces of the said frame; so that after the clothes have been placed over the upper edge of the lower half of the wash board, the upper half is pressed on to them and thus holds them in place. When thus attached, the frame slides up and down vertically between two sets of rollers, the gudgeons of which work in semi-circular arms which are hinged to frame work. One of these frames rests against the side or end of the wash box, and the other has its lower end hinged to the bottom of the box, and its upper end is connected to a weighted lever which presses it against the clothes on the wash board, as they are worked up and down, and the rollers working in the ends of the vibrating semi-circular arms are thus enabled to accommodate themselves to the inequalities which the clothes may present. The frame of the wash board is worked up and down by being suspended to arms projecting from a rocking shaft. The patentee says, "I claim, &c., first, the manner in which I have arranged and combined the rollers on semi-circular arms vibrating on their centres upon vibrating arms, and regulated in their action by a lever borne up by means of a weight. Secondly, the combination of the rollers attached to the semi-circular arms with the vibrating frame and fluted wash boards."

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36. For an improved *Seed Planting Machine*; George Page, Baltimore, Maryland, May 25.

This patent was granted for improvements on that kind of planting machine in which the seeds to be planted are taken from a receptacle by cups attached to a belt passing around two rollers, one of them placed near the bottom of the receptacle, and the other at a suitable height above it; the seeds are put into a hopper, of which the receptacle constitutes a part, but is divided from the main body by means of a sliding shutter, not reaching to its bottom, thus admitting the seeds to pass into the receptacle, but not higher than the bottom of the shutter, thereby preventing their insinuating themselves between the belt and the lower roller. The second improvement consists in attaching to the frame of the machine, a wheel for marking the distance of the rows, this is attached by means of two rods which hook on to the said frame so that it can be reversed at pleasure. The claim is to "the manner of combining the hopper and the receptacle with the sliding shutter, so as to govern the level of the seed in said receptacle, and thus to regulate the feed, in combination with the elevating belt; and also the attaching of a separate marking wheel to the frame of the planter as described."



37. For a mode of making *Metallic Sleigh Runners*; Arunah Spear, Braintree, Orange county, Vermont, May 25.

The patentee says, "the shoe, hub, and raves are connected together by a panel crossing alternately from one side of the runner to the other. This panel is made a little thicker directly under the hub than it is at each end of the runner. The panel and raves so connect the hub and shoe as to form merely, if not quite, a universal brace, in every point liable to exposure or injury. The panel, crossing the runner alternately, places the edges, liable to be broken, at a much greater distance than the mere thickness of the panel, thereby greatly increasing the strength, with but a small increase of weight. What I claim, &c., is the construction of the runners of a sleigh of iron, or other metal, in the manner above set forth, so as to cause the strain, arising from a pressure on one side of the runner, and a pulling on the other, in a manner tending to break the same, to act mainly on the edge of a thin piece of iron, or other metal, thereby avoiding an inconvenient weight, and preventing the centre from operating as a fulcrum over which to break the sides of the runner, rave, or panel."

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38. For a *Life Preserver, or Buoyant Dress*; Rufus Porter, Bellerica, Middlesex county, Massachusetts, May 25.

This dress is made like a pair of pantaloons, with boots, and extending to the arms, with straps passing over the shoulders. A buoyant circle is made around the body of the dress in several separate air-tight chambers, each provided with an inflating tube; and to each leg is attached a set of circular fins, made like a parachute, which open when moving the leg down, and close when moving up. The claim is to "the making the buoyant circle in several separate air-tight chambers, each provided with a tube for inflating, as described; and also the circular fins or paddles, in combination with the water-proof garment."

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39. For an improved mode of *Making the Clasps for Mail Bags*; James Sellers, and Abraham L. Pennock, Philadelphia, Pennsylvania, May 25.

This invention consists in making the clasp of hickory, or other kind of hard, tough wood, instead of forming it of iron, steel, or other metal. A piece of wood is steamed and bent in a mould of the desired shape, and there retained until it becomes set—it is then divided in two parts, longitudinally, is mounted with hinges, &c. &c., and then the leather is secured to it by rivets. The claim is to "the constructing of a clasp composed entirely of wood, and the adapting the same to, and combining it with bags, for the conveyance of letters, traveling bags, or valises, and such others to which it may be adapted; the said clasps being connected together by hinges of metal, by links, or by any flexible material which may be preferred."



40. For an improvement in the *Cooking Stove*; William Jeanes, Philadelphia, Pennsylvania, May 25.

The base of the stove, which is rectangular, is divided into three chambers by two partitions. The box, or body of the stove which contains the oven, is also rectangular, and stands upon the fire cylinder or furnace, which is cylindrical, and upon four columns or pipes, one at each corner. These pipes open below into two chambers, one on each side of the ash drawer, thus making flues leading from one pipe to the other on each side of the stove, and at their upper end these pipes open into the compartments into which the body of the stove is divided. There is also an opening in the bottom plate of the body of the stove communicating with the furnace. Between the bottom plate of the body or box of the stove, and the bottom plate of the oven, there is sufficient space for the flue, and a similar space is left between the top plate of the oven and the top plate of the box. A partition plate passes from end to end of the box or body of the stove, outside the oven, dividing it into front and back chambers; this partition extends from the top plate and down at each end to the bottom plate. Through this partition there is an opening immediately above the oven, which constitutes the only communication between the front and back compartments of the box, excepting through the columns. This opening can be closed at pleasure, by a sliding damper. The end plates of the oven in the back compartments extend down to the bottom plate of the box, so that all direct communication with the flue under the oven, and with the back compartments, is cut off. The smoke pipe on the top plate is placed over that part of the flue above the oven which is behind the partition.

The patentee says, "what I claim is the particular manner in which I have constructed, arranged, and governed the passages for the draught from the fire, as above described. That is to say, the manner in which I have divided the box or body of the stove containing the oven, into two chambers or compartments, by means of the partition, cutting off all communication between said compartments, excepting through the opening in said partition, or through the columns," &c. &c.

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#### SPECIFICATIONS OF AMERICAN PATENTS.

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*Specification of a patent for an improved apparatus for taking Daguerreotype Likenesses. Granted to ALEXANDER J. WOLCOTT, city of New York, May 8th, 1840.*

To all to whom these presents shall come: Be it known that I, Alexander S. Wolcott, of the city of New York, and State of New York, have invented a new and improved method of taking likenesses from life, of which the following is a full and exact description. At one end of a box a concave reflector (which may either be a piece of solid metal, or of glass silvered,) is placed, with the reflecting surface facing the other end, which has an opening corresponding to the size

of the reflector. In this opening is a light metal frame fixed by a thin support to a piece of wood or other material, with which it slides on the bottom of the box, in a direction perpendicular to the face of the reflector and length of the box; this frame is intended to carry the metallic plate, paper, or other material, on which the impression is to be made—the plate, paper, or other material, may be retained in the proper position against the frame by a small spring, pressing the plate, paper, or other material, on the back, and between which spring and the frame, the plate, paper, or other material, is slid. A small door should be made on the top of the box for the purpose of observing the focal image. The box should be placed on a table, or other support, at such height that the centre of the reflector may be as high as that part of the person which is intended to be in the middle of the picture; when a very small picture of the person is intended to be taken, the focus may be adjusted by a microscope, which may be introduced through a hole in the top or side of the box, or held by the hand, at the door-way on the top. When the camera (that is the box with the reflector,) is to be used, the person whose likeness is to be taken, should be placed in a chair, to which some suitable support for the head is attached, to enable him to remain perfectly still. The camera should then be placed with the open end immediately opposite to the person, a trial plate is then to be placed or put against the frame that stands in the open end of the box, and the focus adjusted by sliding the piece to which it is attached; the trial plate is then to be removed, and the plate, paper, or other material, (prepared in any of the well known methods for being acted on by luminous or other rays,) put into its place, and allowed to remain as long as required, to form the image. A convenient size for such camera would be as follows: the box inside, fifteen inches long, eight and a half inches high, and eight inches wide. Reflector, seven inches clear diameter, and twelve inches focus. The plate, paper, or other material, on which the picture is to be formed, is two and a half inches long by two inches wide.

For taking likenesses for breast pins, the reflector may be about two and a quarter inches diameter, and four inches focus, and all the other parts of the camera of proportionate size. That which I claim as my invention, and desire to secure by letters patent, is the taking of likenesses from life, by the aid of a concave reflector placed so as to receive the rays from the person whose likeness is to be taken, and converge them to a focus, on a prepared plate, paper, or other material placed between the person and the reflector.

ALEXANDER J. WOLCOTT.

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*Specification of a patent for an improved mode of converting Mattresses into Life Preservers. Granted to HENRY BLAKE BOURNE, city of New York, May 8th, 1840.*

To all whom it may concern: Be it known that I, Henry Blake Bourne, of the city of New York, and State of New York, have invent-

ed a new and useful arrangement, for the purpose of converting the mattress, or mattresses, of ships, steamboats, and all passage vessels, into a preserver of life and property, and I do hereby declare that the following is a full and exact description. The nature of my invention consists of the peculiar arrangement and adaptation of the common berth mattresses now in use, into a life and property preserver. To enable others to make and use my invention, I will proceed to describe its construction and operation; I take a common berth mattress (hair or spring,) measuring, generally, some six feet in length, two feet four inches in width, and about six inches in depth, and intersect it in the narrow sides; I then remove the hair, or whatever it is stuffed with, and cover the surface of each open half with common ticking, or any other fabric, forming two separate mattresses. I make two water-proof chambers of the length and depth of each half mattress, and about one-third or one-quarter of their width, and stuff them with broken cork, or with hair, or whatever occupied the same place before, or with a mixture of hair and cork, and insert one lengthwise into each half mattress, against one of its longitudinal edges, replacing the remainder of the stuffing into the other part of each half mattress, and sew them up, thus forming two separate mattresses stuffed as before, with a part of each water-proof and buoyant. A double-bladed oar is secured on one of the edges of one-half mattress, and two shoulder-straps on one of the edges of both half mattresses.

I then form a separate water-proof chamber or enclosure, having two sides of corresponding area with the broad surface of the mattresses, or less, and I join the upper and lower longitudinal edges by a diamond-shaped slip of water-proof cloth. In the centre of one of the slips is an aperture, with a band around it, and running string, and to the other, two water-proof leggins are attached. There is a slip about two inches wide projecting over the longitudinal edges, circumscribing the two diamond-shaped slips, to which the half mattresses, (the water-proof enclosure being laid between them) are buttoned, sewn, or anywise fastened. The operation may be as follows.

When used as a mattress to sleep upon, the legs are laid underneath, the oar and straps lying against either side of the berth, and it then differs in no respect from those in present use; but on an emergency, the tenant of the berth thus provided, takes the article out, places in the water-proof enclosure through the aperture, whatever valuables he may desire, or have time to preserve, papers, monies, clothes, and provisions for many days; he then puts his feet into the leggins, draws the string around the aperture close round his chest, and by placing his arms under the shoulder straps, he is enabled by the leggins to go on deck and jump overboard—when in the water, he can use the oar attached to navigate with; the depth of the mattresses will protect his vitals, and, when on shore, the leggins again enable him to retreat beyond the reach of the returning wave. The article, if preserved, will answer as such again, being capable of all necessary repairs.

What I claim as my invention, and desire to secure by letters patent, is the method of adapting the common berth mattresses to a life and property preserver, by making a water-tight chamber, pro-



vided with leggins between the two halves of the mattresses, for the purpose, and in the manner described. I also claim the making a portion of each half of the mattresses buoyant, for the purpose, and in the manner described.

HENRY BLAKE BOURNE.

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*Specification of a patent for an improved mode of constructing Dry Docks. Granted to JOHN S. GILBERT, city of New York, May 12th, 1840.*

To all to whom these presents shall come, be it known that I, John S. Gilbert, of the city of New York, in the county and State of New York, Engineer, have invented certain new and useful improvements in the construction of dry docks, to be of wood or of sheet iron, the bottom to be strengthened with timbers, which I term clamps and buttresses. Also a water stopper for preventing leakage at the entrance gates, which I term a hydrostatic water stopper, of which improvements the following is a full and exact description.

The buttresses are timbers bolted one upon the top of another, starting on the upper clamps (to which they are fastened,) far within a plumb line dropped from the side of the largest ships, for which the dock is intended, thence running up on such angle as shall leave breadth opposite the bilge of the ship (when she sets on the blocks,) sufficient to enable the workmen to stand upon them and caulk, or otherwise repair, the bottom of the ship. As a general rule, I divide the width of the dock into three equal parts, the lower edge of the buttresses extend across one-third of the bottom on each side, and thence run upon such angle as shall intersect with the upper edge of the perpendicular sides of the dock. By this mode of construction, only one-third of the transverse section of my dock is left unsupported, (except by the timber under the keel.) This method, I have reason to suppose, is an improvement on the usual method of building floating docks, inasmuch as I can build my dock wider, and yet leave less width of bottom unsupported; by means of this increased width I obtain a greater degree of light at the keel of the ship, and likewise a greater degree of steadiness, and when the inner or slanting sides of these buttresses are planked up, if such should be deemed advisable, it will form a dock that will retain less water after the ship is floated in, than any other form, shape, or construction.

The bottom and buttresses thus combined, form as near as may be, an inverted arch to the buttresses. Shores are attached, with joints to allow of their being made to rest against the dock frame or sides of the ship, thereby forming, as near as may be, an opposite arch to that formed by the bottom and buttresses. It will be seen, upon examination, that no brace work, or other mechanical contrivance, can offer so perfect a resistance to the upward and lateral pressure of the water as these solid dead woods, as they depend entirely upon their own strength.

The advantage which I derive from this my method of construct-



ing and strengthening the bottom of my dock are various, amongst the most important is that of being able to operate with it in shoal water; for, as the quantity of timber required to be laid crosswise to give to the bottom of the dock sufficient strength to sustain the weight of the class of ships for which it is intended, must depend mainly upon the length of said cross timbers between supporters; it will be seen at once that my plan of letting the buttresses extend from the sides of the dock at least one-third across the bottom on each side, shortens that part which cannot be strengthened but by an increase of timber placed under the keel, and consequently I am enabled to set the keel of the ship much lower than by any other mode of construction. No allowance need be made for the lower clamps, in calculating the depth of water to operate in, as they will settle into the mud.

Another advantage of my plan is, that I have dispensed with all water-tight chambers below the keel, in the middle of the dock, the workmen can therefore stand upon the lowest point in the dock, and as a part of the cross timbers are below, or on the under side of the bottom, they can easily step over the upper clamps, which would be difficult if they were all on top. Another and still greater advantage to be derived from this, my plan, is the perfect security against leakage. The usual method of constructing single bottom docks, as well as ships and other floating vessels, is to fasten the planks on the under side of all the floor timbers, the caulked joints are thereby brought (especially in the case of docks,) on the outer line of the circle given to the bottom of the dock by the weight of the ship resting on the centre blocks, it has been found impossible to keep the bottom joints from opening and shutting.

The method by which I fasten my dock together is to bolt the bottom on to the lower clamps, and caulk it on the upper side, the upper clamps are then placed directly over them, and are bolted through and through. Supposing the upper clamps to contract as much as the lower ones expand, there will be no important effect produced upon the caulked joints. But in addition to all the advantages to be derived from this my method, as above set forth, I am enabled by the use of the upper and lower clamps, to build my dock in the water, instead of the usual and expensive method of building on the land, and I thereby save the trouble and danger of launching. The buoyancy of the lower clamps may be increased if it is not sufficient, by other buoyants, until the fore and aft timbers that form the tight bottom are fastened and caulked; the streaks and layers of timbers that form the sides are caulked as they are laid up, so that the joint to be caulked is always above water. The hydrostatic stopper is a leathern hose, or hose of other flexible water-tight substance, placed in a groove, of half a circle, more or less, cut into the frame, made of the shape of the entrance of the dock, or other parts of the dock, where its use may be required as a water stopper, so that the frame may be removed, if necessary, in order to repair the hose. The manner in which I apply the said water stopper is to fill it after the entrance gates are closed, with water or other liquid, so that an outer

pressure is produced sufficient to stop the water from passing between the hose and gate. When the dock is to be filled with water, in order to float out the ship, the liquid is drawn off through a faucet.

Having thus fully described the manner in which I construct the bottom and buttresses of my dock, and also the mode of using my hydrostatic water stopper, I do hereby declare that what I claim therein as my own invention, and desire to secure by letters patent, is, first, the particular manner of arranging the cross timbers by placing a part below, and a part above, the caulked bottom, thereby securing said caulked bottom between clamps, for the purpose of preventing the opening and shutting of said caulked seams, &c. Second, the employment of a hydrostatic water stopper, for the purpose, and in the manner heretofore described in this specification. In testimony whereof, I, the said John S. Gilbert, hereunto subscribe my name in the presence of the witnesses whose names are hereto subscribed, on the 22nd day of April, A. D., 1840.

JOHN S. GILBERT.

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*Application of the process of Gilding in the moist way, to the Art of Engraving.*

(Extract of a Letter from Professor DELA RIVE to M. DUMAS.)

Mr. Hamman, an engraver of our city, (Geneva,) has just made an interesting application of my process of gilding, to the art of engraving, by aquafortis. He gilds the plate of copper designed to receive the engraving, instead of covering it with wax, and then traces upon its surface the lines of his design, removing the gold wherever the point passes. He then spreads over it the aquafortis, which attacks and corrodes the copper wherever it is exposed. This process seems to have several advantages over that in which wax is employed. In the first place, the coating of gold being permanent, the plate may be corrected if the proofs show faults; in the other process, when the wax is removed, it is very difficult to make any corrections. Moreover, the lines which are traced upon the coating of gold may be made much more fine and delicate than those which we find upon wax. It appears that gilding by mercury, besides being much more expensive, does not present the same advantages and facilities in application.

Annales de Chemie et de Physique.

| LUNAR OCCULTATIONS FOR PHILADELPHIA,<br>AUGUST, 1841.<br>COMPUTED BY JOHN DOWNES. |      |      |              |             |                   | Angles reckoned to the right or west-<br>ward round the circle, as seen in an<br>inverting telescope.<br>For direct vision add 150°.  |                        |
|-----------------------------------------------------------------------------------|------|------|--------------|-------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Day.                                                                              | H'r. | Min. | Star's name. |             | Mag.              | From Moon's<br>North point.                                                                                                                                                                                            | From Moon's<br>Vertex. |
| 1                                                                                 | 15   | 59   | Im. 19       | Capricorni, | 6                 | 99°                                                                                                                                                                                                                    | 41°                    |
|                                                                                   |      |      | Em.          |             | <i>invisible.</i> |                                                                                                                                                                                                                        |                        |
| 19                                                                                | 7    | 32   | Im.          | γ Virginis, | 5.6               | 99                                                                                                                                                                                                                     | 147                    |
|                                                                                   |      |      | Em.          |             | <i>invisible.</i> |                                                                                                                                                                                                                        |                        |

### Meteorological Observations for May, 1841.

| Moon.                            | Days | Therm.       |           | Barometer.   |              | Wind.      |            | Water<br>fallen in<br>rain. | State of the weather, and<br>Remarks. |
|----------------------------------|------|--------------|-----------|--------------|--------------|------------|------------|-----------------------------|---------------------------------------|
|                                  |      | Sun<br>rise. | 2<br>P.M. | Sun<br>rise. | 2<br>P.M.    | Direction. | Force.     |                             |                                       |
|                                  |      |              |           | Inch's       | Inch's       |            |            | Inches.                     |                                       |
|                                  | 1    | 46           | 54        | 29.35        | 29.35        | W.         | Brisk.     |                             | Cloudy—flying clouds.                 |
|                                  | 2    | 44           | 50        | .64          | .45          | W.         | do.        | .05                         | Cloudy—shower—hail.                   |
|                                  | 3    | 31           | 43        | .76          | .80          | W.         | do.        |                             | Clear—frost—cloudy.                   |
|                                  | 4    | 34           | 50        | .84          | .86          | W.         | do.        |                             | Clear—do                              |
| ☺                                | 5    | 33           | 55        | .80          | .80          | W.S.       | Mod. rate. | .33                         | Clear—white frost—rain.               |
|                                  | 6    | 42           | 53        | .75          | .80          | W.         | Brisk.     |                             | Clear—flying clouds.                  |
|                                  | 7    | 40           | 52        | 29.10        | 30.00        | NW.        | Moderate.  |                             | Clear—cloudy.                         |
|                                  | 8    | 44           | 57        | 29.80        | 29.90        | NE.        | do.        | .65                         | Rain—cloudy.                          |
|                                  | 9    | 45           | 70        | 30.00        | 30.08        | W.         | do.        |                             | Clear—hazy.                           |
|                                  | 10   | 50           | 59        | 29.80        | 29.55        | E.         | do.        | .45                         | Rain—do.                              |
|                                  | 11   | 51           | 65        | .40          | .40          | W.         | Brisk.     |                             | Clear—flying clouds.                  |
|                                  | 12   | 54           | 64        | .43          | .44          | W.         | Caln.      | .14                         | Cloudy—showery.                       |
| ☾                                | 13   | 45           | 64        | .65          | .65          | W.         | Moderate.  | .13                         | Clear—shower.                         |
|                                  | 14   | 41           | 62        | .70          | .73          | W.         | do.        | .07                         | Clear—shower.                         |
|                                  | 15   | 42           | 64        | .85          | .90          | W.         | do.        |                             | Clear—flying clouds.                  |
|                                  | 16   | 42           | 64        | .96          | .96          | E SW.      | do.        |                             | Clear—flying clouds.                  |
|                                  | 17   | 52           | 64        | .85          | .60          | W.         | Brisk.     | .01                         | Cloudy—shower.                        |
|                                  | 18   | 46           | 66        | .75          | .76          | W.         | do.        |                             | Clear—flying clouds.                  |
|                                  | 19   | 46           | 66        | .80          | .84          | W.         | Mod. rate. |                             | Partially cloud—do. do.               |
| ⊗                                | 20   | 44           | 71        | .94          | 30.04        | W.         | do.        |                             | Partially cloudy—clear.               |
|                                  | 21   | 48           | 78        | 30.10        | .00          | SW.        | do.        |                             | Clear—do.                             |
|                                  | 22   | 57           | 86        | 29.94        | .00          | W. SW.     | do.        |                             | Hazy—do.                              |
|                                  | 23   | 66           | 83        | .96          | .04          | SW.        | do.        |                             | Cloudy—clear.                         |
|                                  | 24   | 62           | 84        | 30.00        | .00          | SW.        | do.        |                             | Partially cloudy—clear.               |
|                                  | 25   | 63           | 84        | .04          | 29.94        | SW.        | Brisk.     | .43                         | Clear—thunder shower.                 |
|                                  | 26   | 64           | 73        | 29.90        | .90          | SW.        | Moderate.  | .53                         | Cloudy—rain—cloudy.                   |
| ☾                                | 27   | 63           | 70        | .90          | .95          | SE.        | do.        | .13                         | Cloudy—rain.                          |
|                                  | 28   | 64           | 81        | .95          | .98          | S          | do.        |                             | Fog—flying clouds.                    |
|                                  | 29   | 66           | 80        | .95          | .93          | W.         | do.        | .02                         | Drizzle—partially cloudy.             |
|                                  | 30   | 60           | 70        | .90          | .96          | E.         | do.        | .03                         | Drizzle—cloudy.                       |
|                                  | 31   | 50           | 73        | 30.00        | .93          | E.         | do.        |                             | Clear—do.                             |
|                                  | Mean | 49.52        | 66.68     | 29.53        | 29.83        |            |            | 3.010                       |                                       |
| Thermometer.                     |      |              |           |              |              |            |            |                             |                                       |
| Maximum height during the month, |      |              |           | 86.00        | on the 27th. |            | Barometer. |                             |                                       |
| Minimum                          |      |              |           | 31.00        | “ 3rd.       |            | 30.10      | on the 7th and 9th.         |                                       |
| Mean                             |      |              |           | 58.10        |              |            | 29.35      | “ 1st.                      |                                       |
|                                  |      |              |           |              |              |            | 29.83      |                             |                                       |



| County.            | Town.            | Observer.             |
|--------------------|------------------|-----------------------|
| 1 Philadelphia.    | Philadelphia.    | G. P. Schively.       |
| 2 Montgomery.      |                  |                       |
| 3 Bucks.           | Newtown.         | L. H. Parsons.        |
| 4 Lehigh.          |                  |                       |
| 5 Northampton.     | Easton.          | Charles Elliot.       |
| 6 Monroe.          | Stroudsburg.     | A. M. Stokes.         |
| 7 Pike.            | Mifflord.        | Ralph Bull.           |
| 8 Wayne.           | Hone Dale.       | W. Richardson.        |
| 9 Luzerne.         | Silver Lake.     | E. Rose.              |
| 10 Susquehanna.    | Wilkesbarre.     | W. F. Dennis.         |
| 11 Schuylkill.     | Port Carbon.     | P. C. Lyceum.         |
| 12 Berks.          | Reading.         | C. F. Egelmann.       |
| 13 Chester.        | West Chester.    | Wm. W. Jeffries.      |
| 14 Delaware.       | Haverford.       | Haverford School.     |
| 15 Lancaster.      | Lancaster.       | Conservatory of Arts. |
| 16 York.           |                  |                       |
| 17 Lebanon.        |                  |                       |
| 18 Dauphin.        | Harrisburg.      | J. Heiseley.          |
| 19 Northumberland. | Northumberland.  | Andrew C. Huston.     |
| 20 Columbia.       | Danville.        | C. H. Frick.          |
| 21 Bradford.       |                  |                       |
| 22 Tioga.          |                  |                       |
| 23 Lycoming.       |                  |                       |
| 24 Union.          |                  |                       |
| 25 Mifflin.        |                  |                       |
| 26 Juniata.        | Mifflintown.     | J. A. Kinkead.        |
| 27 Perry.          |                  |                       |
| 28 Cumberland.     | Carlisle.        | Prof. W. H. Allen.    |
| 29 Adams.          | Gettysburg.      | Prof. M. Jacobs.      |
| 30 Franklin.       |                  |                       |
| 31 Huntingdon.     | Huntingdon.      | Prof. Jacob Miller.   |
| 32 Centre.         | Bellefonte.      | John Harris.          |
| 33 Potter.         |                  |                       |
| 34 McKean.         | Smithport.       | M. R. Atkins.         |
| 35 Clearfield.     |                  |                       |
| 36 Cambria.        | Ebensburgh.      | Richard Lewis.        |
| 37 Bedford.        | Bedford.         | Samuel Brown.         |
| 38 Somerset.       | Somerset.        | George Mosby.         |
| 39 Indiana.        | Indiana.         | Richard White.        |
| 40 Jefferson.      | Rose Cottage.    | C. C. Gaskell.        |
| 41 Warren.         | Warren.          | J. E. King.           |
| 42 Venango.        | Franklin.        | Wm. Connelly.         |
| 43 Armstrong.      |                  |                       |
| 44 Westmoreland.   |                  |                       |
| 45 Fayette.        | Uniontown.       | J. P. Weetbee.        |
| 46 Greco.          |                  |                       |
| 47 Washington.     | Cannonsburg.     | Prof. A. H. Campbell. |
| 48 Allegheny.      | Pittsburgh.      | J. P. Bakewell.       |
| 49 Beaver.         | Beaver.          | James Allison.        |
| 50 Butler.         | Butler.          | Jacob Mechling.       |
| 51 Mercer.         | West Greenfield. | S. Campbell.          |
| 52 Crawford.       | Meadville.       | J. Limber.            |
| 53 Erie.           | Erie.            | Park & Reid.          |

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**JOURNAL**  
OF  
**THE FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**

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AUGUST, 1841.

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**Civil Engineering.**

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Notes on Belgium.* By CAPTAIN G. W. HUGHES, *United States Topographical Engineer.* Addressed to FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

BRUSSELS, March 3, 1841.

Having been invited by the Superintendent of the National Foundry at Liege, to be present at the casting of some heavy pieces of ordnance, I left Brussels for that purpose, on the 12th of February, intending, if the weather should be favourable, to proceed, before my return, up the Rhine as far as Mayence, and on the Main to Frankfurt, having in view an examination of the principal fortresses in Rhenish Prussia, and of the Free cities, especially the Castle of Ehrenbreitstein, and the other works in the vicinity of Coblenze, which constitute that city the military key to the Rhine and upper Germany.

A railway is open from Brussels to Liege, and the journey is performed in about five hours.

Stopped at Louvain over night, and started early next morning to see the lions of this ancient and curious town. The principal object of interest, and the just pride of Louvain, is the Hotel de Ville, which is regarded as the richest and most perfect specimen of the elaborate Gothic, out of Italy; and so far as ornament is concerned, is said to be inferior only to the Cathedral of Milan. Nothing can be more highly finished and ornate than this structure, for it is literally cover-

ed with carved figures and the minute tracery of fret work. The subject of many of the groups, is the punishment of the passions, which is often executed with more of force than of delicacy. This edifice has been recently perfectly restored, and now appears in the exact condition in which it was originally erected in 1493. It was built of a yellow sandstone, brought from France, in texture and colour resembling the fine grained varieties of the Potomac (Aquia,) free stone, but probably inferior to them in quality. It is certainly not a good material for carved work exposed to the atmosphere, as it disintegrates too readily. When the task of restoration began, there was scarcely a perfect figure or moulding on the façade. The same remarks apply with even more force to the celebrated *Dom Kirche*, of Cologne, which was originally built of sandstone, from the *Drachenfels*, containing a considerable proportion of *glassy felspar*. But for the taste and liberality of the King of Prussia, this magnificent Cathedral would, ere this, have been a mere heap of ruins. From time to time, considerable sums of money have been expended on its repairs; and hundreds of workmen are now employed on the completion of this structure, after its original plan, which, if ever carried strictly into execution, will not leave even St. Peter's without a rival. The King of Prussia has appropriated from his own funds, 1,000,000 of dollars towards this laudable object. The nave, on the completion of which they are at present mainly engaged, is 400 feet long, 161 wide, and 180 feet high, in the choir. The two principal towers, when finished, will be 500 feet high. Mr. Hope, in speaking of it, says, "its interior resembles a splendid vision," and its exterior strikes the beholder with "awe and astonishment." As the whole edifice is surrounded with scaffolds rising to the height of more than 200 feet, I was enabled to pass over every portion of the building, and to wander among the light and airy-flying buttresses, which relieve the walls from the enormous thrust and pressure of the immense arches of the choir. The upper portions of the work are made as light as possible, but are bonded together with copper and iron, and many of the stones are cemented with lead instead of mortar. The repairs are made of Trochyte, from the Drachenfels, which, after being laid, is saturated with oil. I have brought with me, specimens of the materials of this church, and of the Hotel de Ville, of Louvain; also of the red sandstone so much used for building purposes, at Frankfort and Mayence. They may serve as useful guides in avoiding similar errors in our own country; for it is truly lamentable to behold splendid structures, on which so much of genius, of labour, and of treasure, have been bestowed, crumbling so soon under the touch of time.

Beside the Hotel de Ville, I visited the Cathedral of Louvain, once

celebrated for its lofty and pointed spire of 533 feet in height, which was blown down in 1604; a stone model of which may be seen in the Hotel de Ville, which also contains many pictures, by the old masters, *before* the time of Rubens, curious only for their colouring, which is as vivid as the day they were painted, but the drawings are decidedly bad. But the boast of Louvain, in the way of pictures, is the gallery of M. Vanderschrick, containing some of the master-pieces of Rubens, Vandyck, Tennyers, Rembrandt, Wouvermans, &c. &c., which is most liberally thrown open to the inspection of strangers.

At one o'clock left for Liege, which was reached at four, P. M. The country between Louvain and Liege, is rolling—the soil rich, and in a high state of cultivation. It reminded me very much of the better part of the forest of Prince George county, and of the West river district of Anne Arundle, Maryland.

The railway is of a single track, and well constructed. It belongs exclusively to the government, and the police is placed under the sole management of the minister of public works, and is remarkably well regulated. The velocity of traveling is about twenty miles the hour, and accidents seldom happen. In the United States, we are unaccustomed to the interference of government in the management of public works; but certain it is, that nothing can be better regulated, *cheaper* and safer, than railway traveling in Belgium; whilst in England, where it is left to the control of incorporated companies, it is quite the reverse in all these particulars.\* When a train is ready to start on a Belgian railway, a signal is given by the conductor at the head of the train, by sounding a bugle, and so soon as the signal is repeated, in like manner, from the rear, the engine is put in motion.

The railway does not enter the town of Liege, but stops, for the present, at Ans, three miles off. The descent from the station, to the valley of the Meuse, on which the new town is built, is very rapid. It is intended (and the work is rapidly advancing towards completion,) that this road shall be extended to the Prussian frontier, and thence by the way of Aix la Chapelle to Cologne—that portion of it connecting the two latter towns, will be opened for travel in a few months. When this shall have been completed, it will afford, at all seasons of the year, a direct communication with the Rhine, through either Antwerp or Ostend.

It is my intention, so soon as I can collect the necessary documents, to send you a condensed account of the Belgian railways; for it seems to me that many useful hints may be extracted from the system which

\* Recent British publications show "the danger of loss of life on an average railroad trip, to be only one in 4,000,000.—PUBLISHER.



has been adopted here with such signal success. In no other country, I am persuaded, has the great problem of reconciling adequate dividends, with cheap and safe traveling, and consulting, at the same time, public utility, been solved with so close an approximation to exact results.

13th of February—went this morning to visit the Royal Cannon Foundry, under the superintendence of Major Frederickx, of the artillery. These works are very extensive, and in fine order; they consist of two large foundries, of twelve reverberatory furnaces; of two large forge shops of fifteen fires; of one very large trip hammer; an enormous crane to hoist heavy pieces of ordnance from the pits in which they are cast—a furnace for heating large masses of iron, previous to re-hammering them—a large oven in which to dry the moulds—twelve boring and dressing machines, and five steam engines, only one of which is, however, usually employed.

A steam engine, of twenty-five horse power, performs the mechanical labour of the establishment. It was made by Cockerill, at Seraigne, and is a beautiful specimen of mechanism compared with the French engines formerly, and until recently, used for the same purpose. The engine room was very neat, and what was very characteristic of these people, every part of it not in use, was devoted to the culture of hot-house plants, protected by the heat of the engine, kept in constant action, from the inclemency of the weather. The machinery in the finishing room was very perfect, and in good condition. I here observed a machine for cutting and smoothing the trunnions of cannon which worked horizontally, and appeared to me much superior to the machine for the same purpose, with a vertical movement, in use with us. Major Frederickx informed me that he had sent a drawing of it to the United States Board of Ordnance, two officers of which visited this establishment last summer. The superintendent kindly showed me over these works, and explained every thing in relation to them with the greatest urbanity. The moulds for the cannon are composed of a mixture of five parts of silex, two of alumine, and one of coke. The sand and clay are sifted, and well ground together, the coke is minutely pulverized, and these substances are then intimately commingled, having been previously sprinkled with water. The moulds are formed of the required shape and size, by hard ramming in the cast iron pattern, and are then removed to ovens, in which they are well dried. The success of the casting depends on the fidelity with which this has been done. For hollow shot, the proportions are somewhat different, being five parts of sand, one of clay, and one of coke; but for large mortars, (*mortier monstre*, as they are called,) more clay is required than for ordinary guns. The clay is not of that

class of which fire bricks are made, but is very tenacious. This establishment is the first place where coke was used for moulds. In England, fine coal, in its natural state, is employed for that purpose, but it is not believed to be so good. There are no blast furnaces connected with this foundry, for the reduction of ores, and the metal is procured in pigs, mainly from the neighbourhood of Namur. Formerly, much of it was obtained from Seraigne, where, however, they now manufacture all the produce of their furnaces. They sometimes re-melt old iron with the pigs, in the ratio of two to three, for casting ordnance.

There is no one ore in Belgium that yields the requisite quality of metal for cannon, and several kinds are intermixed to produce the proper result. The character and proportion of these ores can be determined only after long practice and numerous experiments. Hence the advantage of a National Foundry, where experiments may be tried under the immediate direction, and at the expense, of government.

It requires a long personal experience to be able to judge with accuracy when the iron is just sufficiently carbonized, and is, in other respects, in that precise state to produce the best possible results. A rigid application, in this regard, of scientific principles, is impossible, and the proper information, on these points, can be imparted only by personal attention, for it depends so much on nice degrees of individual observation that it can be satisfactorily communicated in no other form.

It has been ascertained that the best gun metal is the produce of an ore containing a small proportion of calamine. The ores in general use are of several kinds, including the red and brown hematites, carbonates, limonites, and those peculiar to the coal measures.

This establishment is too large for the wants of the Belgian Government; in consequence of which they cast cannon for other nations; and the ordnance fabricated here is understood to be of a good character, both as to model and quality.

I here saw a colossal statue, in bronze, recently cast for the city of Antwerp, of Peter Paul Rubens, the greatest of Flemish painters. It is after the design of Géefts—one of the most eminent of modern sculptors—and has been much admired. It is, however, a statue rather of the ambassador than of the great artist. Its height is nearly fifteen feet, English, and it weighs over 14,000 lbs.

In the course of the day I saw hollow shot, and a ten inch mortar, weighing about three tons, cast. The mould, encased in cylindrical cast iron frames, screwed together, and wedged tight, was placed vertically in a pit, and carefully sustained in its position by means of

wooden shores fitting into recesses in the walls. A good deal of gas was disengaged during the process of casting, at the joints of the frames, which burned with a blue lambent flame. It was probably carburetted hydrogen gas, formed by the decomposition of the very slight degree of moisture which had not been expelled from the mould, and the combustion of a small portion of the coke, one of the constituents of which the mould is made. It requires great care in drying the moulds before the metal is run into them, else the most frightful accidents may ensue, by the sudden generation and expansion of steam, carrying with it, and scattering in all directions, the melted metal. It was by neglecting the necessary precautions, in this respect, that the lamentable accident happened in the vicinity of London, by which the whole foundry was destroyed, and a large number of persons were killed or frightfully wounded. This led to the establishment of Woolwich, under the superintendence of a young German, by the name of Schwartz, (if I am not mistaken,) who, having discovered just before the casting took place, that the moulds were not sufficiently dry, reported this fact, and pointed out the fearful consequences that would probably ensue, to the proper authority; but in the pride of official opinion these representations were unheeded, and the result was most awful. No serious accidents have occurred at these works, owing to the many precautions which are taken to prevent them, when large castings are run; but with small pieces they are not so careful, and a few weeks before my visit an explosion took place in casting a small eprouvette, but no great injury was sustained.

The pigs and old scraps intended for ordnance, are melted in a reverberatory furnace with bituminous coal; and the metal is conducted from the furnace directly to the moulds. The quantity of iron put in the furnace is very nicely graduated to the size and weight of the required casting, so that a very small surplus of metal remains in the furnace, and this is run again into pigs for future use, or sometimes immediately into hollow shot. The large mortar used at the siege of Antwerp was cast at this foundry.

All the guns are cast solid, and then bored to the required calibre, the first boring being of the size of the chamber. Every piece of ordnance is proved with extremely heavy charges of powder and ball, but I did not observe any of the very nice machinery used at Woolwich, to ascertain if the boring of the guns, and the thickness of the metal corresponded with the specification, and if the line of collimation be precisely accurate. Shells are tested by pneumatic and hydraulic pressure. Eprouvettes, for testing the strength of powder, are made of cast iron instead of gun metal.

The same day visited the church of St. Jacques, celebrated for its



painted windows—the Citadel is a very strong work, and the Museum of Natural History, which contains an extensive and well arranged cabinet of minerals and geological rocks—among them a complete suite of the beautiful Belgian marbles, and a perfect collection of coal fossils, are particularly worthy of commendation.

The junction of the three valleys of the Meuse, Ousthe, and Vesdre, close to Liege, forms a landscape of no ordinary character.

16th February, at eight o'clock in the morning, left for Seraigne, having obtained permission from the proprietors to visit the extensive mines, iron works, and factories at that place. It is about five miles up the Meuse, from Liege, on the opposite side of the river. The ride up the valley of the Meuse is most beautiful—the valley is not wide, but the soil is extremely rich, and in the highest possible state of cultivation. It is indeed but a continual succession of villages, chateaus, and gardens.

The works at *Seraigne* occupy the palace and grounds of the last Prince Bishop of Liege. The palace is very large, and was formerly a most rich and beautiful edifice, but the present establishment is nearly three times its original size.

Nothing can afford a more striking illustration of the utilitarian spirit of the age than a visit to this ancient palace and modern workshop; and in no other country, perhaps, can be found more signal instances of the mutability and shifts of fortune. This idea is beautifully expressed by Bulwer, in the following extract, which I have ventured to alter by changing a few words, to render it the more applicable to the present case. "You will find the kingly city dwindled into the humble town or the dreary village; exhibiting decay without its grandeur, change without the awe of its solitude. On the site on which Drusus raised his Roman power, and the Kings of the Franks their thrones, trade now dribbles in tobacco pipes, and transforms into an excellent manufactory the antique palace."

The machine shop is very extensive, being the largest of the kind I have ever seen, and is the greatest metallurgical establishment in Belgium. The wages paid to the operatives average about seventy-five cents per diem. It is estimated that from 40 to 50,000 lbs. of machinery is sent out, finished, every day, from this work-shop. The entire establishment, including rolling mills, furnaces, and mines, (worked within the walls,) gives occupation to about 3000 persons, nearly one-third of whom are females. The operatives are principally Belgic walloons, a very industrious, tractable race; in mechanical ingenuity but little, if at all, inferior to the British. But the machinery struck me as being, on the whole, not equal to the English; and in



many cases, I observed manual labour substituted for mechanical, but that was probably attributable to the cheapness of that kind of power in Belgium. There is an Englishman (the only one connected with these works,) in charge of the blast furnaces. He says his countrymen are soon spoiled when transplanted from their native soil, and become very worthless. To use his own language, "John Bull, like the Bull of Bashan, waxes fat and kicks."

It is here many of the locomotives for the Belgian railways, and nearly all the machinery employed in the kingdom, are constructed. I saw, in different parts of the shop, wrought iron wheels for locomotives, in progress of construction. The wheel is composed of as many segments as there are spokes—each segment is forged with a short spoke projecting from it. This projection is welded to the corresponding portion of the spoke, previously fixed with lead in a cast iron hub; and the segments are successively welded to each other. To these segments is welded on the exterior a continuous well hammered iron rim and flanch, which forms the tire, so to speak, of this wrought iron wheel. After this welding, it is chilled to a proper temper.

In another part of the shop they were forging the immense shafts for the fixed engines intended for the two inclined planes at Ans, near Liege, by which the railway descends to the valleys of the Meuse and Vesdre.

The machinery of the inclined planes consists of two pairs of low pressure and condensing steam engines, fixed on the intermediate stage of the inclined planes, each being intended to move at pleasure the rope which passes from the superior to the inferior plane.

The cylinders of the steam engines are to be forty-nine inches (english) in diameter, and fifty inches long, (for the movement of the piston.)

Each pair of engines to possess a collective power equal to that of 160 horses; the horse power being estimated equal to the power required to raise over a simple pulley a weight of 150 lbs. three feet high in one second of time. The tension of the steam in the boilers is not to exceed the pressure of the atmosphere more than one-third of a kilogramme per the square centimetre, or of about eleven ounces to the square surface of four-tenths of an inch.

These engines are provided with six boilers, formed each of twelve interior tubes. Each set of boilers, (composed of three,) is to be able to generate sufficient steam for the two machines, and also, if necessary, for the small supplemental engine of ten horse power, which is intended to exhaust the cylinders of the large engines, and to supply the boilers with water by pumping from the river.

The cost of this machinery is as follows:

|                                                                                                      |             |
|------------------------------------------------------------------------------------------------------|-------------|
| For the two steam engines, all the accessories included,                                             | 380,000 fr. |
| For transporting and setting them up at the planes,                                                  | 20,000      |
| For the supplemental engine, and setting up,                                                         | 11,300      |
| For incidental charges of various kinds in fitting up the<br>planes, furnishing reservoirs, &c. &c., | 20,600      |
|                                                                                                      | <hr/>       |
|                                                                                                      | 431,900 fr. |

Equivalent to about \$80,000 in round numbers.

All the axles for fixed and locomotive engines are formed of fagot-  
ted iron—that is iron of the best quality, first rolled into small rods,  
and firmly welded together, while red hot, by a ponderous trip-ham-  
mer. It is in this way all parts of machinery liable to injury from  
sudden concussions—especially the axles of cars and locomotives, the  
breaking of which may involve such a fearful loss of human life—  
should invariably be fabricated; but the manufacturer too often sub-  
stitutes chain cable iron (good as it is for most of purposes,) in its  
stead; which an engineer should never, knowingly, on any considera-  
tion, permit.

These works also supply the greater portion of the Belgic railway  
iron, which they were selling in large quantities while I was present,  
for the extension of the road from Liege to Aix la Chapelle, in Prus-  
sia. It is of the T form—weighs about forty-six lbs. per yard, and  
costs about \$50 per ton, delivered at Liege. There is, however, con-  
siderable variation in the weight and prices of the rails for different  
sections. The chairs by which they are held weigh ten lbs., and the  
rails are fixed in them by wooden wedges. The old scoria is re-melt-  
ed in a mixture of *half and half* with the natural ores, to produce  
rail road iron. After going through the usual processes of reduction,  
refining, puddling, &c. &c., they are twice rolled—then heated and  
rolled seven times in quick succession, before the rail is perfectly  
formed. It is probably owing to these numerous rollings that they  
are enabled to produce good rails, after using so large a proportion  
of scoria in the original reduction.

The rails on the Belgian roads are united at an angle of 45°, (forming  
a joint in my opinion equal to a square one.) The rail is not cut as in  
England, but after being heated, is placed in a *steel mould*, and then  
hammered down to the required angle.

The test of a railway bar is a weight of 860 lbs. falling on it from  
a height of 16½ feet. If the fibre be broken it is rejected. If it stands  
the test it is again rolled. To make the rails perfectly straight, they  
are brought under the pressure of a machine turned by a lever, and  
worked by manual labour.

There is a small steam engine in each shop, and in the rolling mills

one engine of 100 horses power, with an immense working beam. The aggregate power of the steam engines used in the establishment is equivalent to that of 800 horses.

The locomotives manufactured here are of five classes, the diameter of their cylinders being respectively 11, 12, 12½, 13, and 14 inches English, and costing from \$7,000 to \$8,000. A new engine which I saw at the work-shop, of 13 inches, cost 39,000 francs.

The large lion on top of the Waterloo monument, was cast at these works.

Connected with these works, are two blast furnaces in constant use. All the coals are coked, and yield about seventy per cent. No iron ores of much account are found with the coal, but overlaying the coal seams, some good ores have been worked in what is called the Anglier mine, yielding about sixty-five per cent. of excellent metal, well suited for ordnance, as it contains a small proportion of zinc. It has also some lead, but it is usually freed entirely from this latter substance, and forms a good deal of the former, as is shown by the white deposits on the chimney tops. This ore resembles, in other respects, the Lancashire ore, in appearance and quality. The most of the ores worked here are brought down the Meuse, from the vicinity of Namur—they resemble the Devon and Cornish ores, yielding about thirty-six per cent. of good metal. Some of them appear to be a species of ochreous or ferruginous clay.

The works at Seraigne were planned by Mr. David Muchet, (whose reputation as an iron master is well known,) for Mr. John Cockerill, an enterprising Englishman. They seem to be very well arranged, and to answer perfectly the purposes for which they were designed. It would appear, however, that the furnaces had not formerly been well managed, as they are now re-melting the old scoria, which had been accumulating for years, from which they obtain over thirty per cent. of metal.

On the top of the stack of furnaces is placed a small engine, which draws the charge of ore, fuel, and flux, up an inclined plane. The hot blast is sometimes, but not often, used. Without it, about three tons of coal, and fifteen cwt. of limestone, are necessary to produce one ton of pig iron. With the hot blast, these items are much diminished, but the quality of the metal is deteriorated, owing, probably, to the development, by an extreme degree of heat, of the metal-loids, or bases of the earths, which combine with the melted iron, and impair its quality. To a certain extent these extraneous substances may be expressed by rolling, but to expel them radically, must be a difficult undertaking.

The coal is worked at a depth of nearly 1200 feet, and is elevated



by machinery, as in England. There are, here, seven different seams, but several of them are too thin to be worked; the thickest is six feet. The coal is very similar to the ordinary Welsh coals, in appearance, and burns like them. These mines are liable to explosions from fire damp, and several persons had been killed a short time before my visit. After the accident, the proprietors ordered a large number of *Davy's Safety Lamps*, which I saw sent down the pit. I could not ascertain, clearly, whether they had used them before the accident took place, but am inclined to believe they did not.

Coal, through this region, is very abundant, in consequence of which manufactories of different kinds have sprung up on all sides. Formerly, Holland was supplied with coal from Belgium; but the home consumption, since the revolution, has increased beyond the supply of the Belgian mines, and a law has been passed, permitting the importation of coal from Great Britain.

Another large iron establishment is the property of a society in Brussels. It is next in size and importance to the works at Seraigne, and is calculated to employ 3000 workmen, whenever there may be a necessity for so large a force, which is not likely soon to occur. At present, there are not 300 persons connected with the establishment. Some of the locomotives for the Belgian railways are manufactured here. They obtain their refined iron from Austria, and pay about \$35 per ton for it.

[TO BE CONTINUED.]

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Removal of Obstructions in the Mouth of the Mississippi.*  
By A. C. JONES, Engineer.

GENTLEMEN:—Having seen in the newspapers several projects for deepening the water, or removing the bars at the passes of the Mississippi river, I am induced to give a sketch of what was done by the United States steam dredger Balize, as I am firmly convinced that the only feasible plan for improving the passes is by dredging. First removing all the lumps in the ship channel, and then deepening the bar by carrying it away as raised. It is idle to talk of daming, ploughing, or dragging, as these projects would never enter the brain of any person that was conversant with the difficulties to be encountered.

An impression exists that the bars consist of soft mud, and are easily removed. This is erroneous, for the bars are hard, and studded with mud lumps, which are forced by some subterranean agency through the bottom, and up sometimes as high as ten feet above the surface of the water. These lumps consists of a compact clay (alumine,) of the consistence of cheese, and the surface receives a fine



polish when cut with a sharp knife. The action of the water has very little effect on the lumps, (some have perpendicular sides,) except during severe storms, when the tops are washed off to the surface of the water. When the surface is slightly inclined, it is generally covered with innumerable clay pebbles, the fragments of the lumps taking that form by the action of the waves on them.

For a perfect understanding, I will give a short history of the Dredger from her commencement. The boat was built by John Vaughan, at Kensington, in a substantial manner, and the engine and dredge machinery, by Messrs. Levi Morris and Co. ;\* all being fair specimens of Philadelphia workmanship. The whole being under the immediate direction of Captain Andrew Talcott, United States corps of Engineers. The machinery for one side being so far completed as to make a partial trial in the dock; all bidding fair to perform well. The boat was hurried off in the early part of January, 1838, before the full completion of her machinery, through fear of being detained by ice. The Balize did not prove to be a good sea boat, owing to the peculiar distribution of the machinery on board, and in consequence of the roughness of the sea, caused considerable rolling; the boilers being cylindrical, and on the guards, at times, it was difficult to keep the water at the proper height. I found great benefit in knowing the level of the water, by the use of my gauge tube, as described in the Journal; the ordinary gauge cocks giving incorrect results, especially when foaming. The boat drawing nearly two feet more water than her proper draught, made the passage long.

I may mention here that I found the carbonate of lime in the boilers increase in quantity, in a given time, as we proceeded South, although the precaution of cleansing the boilers at the stopping places, and constant blowing, was strictly attended to during the voyage.

On the arrival of the boat at the North East pass, it, and all the force, was put in requisition to assist the corps of engineers in the survey which was then going on; and it was late in the season before all the necessary fixtures were completed to commence dredging. After several trials, it was found that the chain being part of cast iron, (although proved to a strain of twenty-seven tons, at Philadelphia,) frequently broke, owing to the hardness of the bottom, coupled with the great size of the buckets, the contents of each being one cubic yard. New chains were immediately ordered, but owing to shipwreck, and other causes, the chain for one side, although first made, did not arrive until eight months after. On the receipt of chains for

\* As a proof of the excellence of the workmanship of the engine, I will give *one* example. When I left the boat, the key of the connecting rod, at the cross head end, remained as driven when steam was first applied to the engine, it not having been required to alter it.

one side, numerous experiments were tried at different parts of the bar, perfecting the machinery, and drilling the men. In November, orders were received to proceed with the dredger to Red river, to remove a bar at the mouth of the Chute—prior to our arrival, the pent up water had cut a channel of sufficient depth. The only obstacle was an island of mud, 140 feet long, and fifty feet at its greatest breadth; the whole being two feet above the surface of the water. The dredger was moored alongside, and operated on it with the buckets of one side, and in twenty-three working hours, one-half of the island was removed down to thirteen feet water. As the particles of mud were only carried away by the current, the same mud was raised by the buckets several times, and as many of them came up heaped, so as to contain two cubic yards, it was computed that the dredge raised the enormous quantity of 600 cubic yards per hour,\* which is far surpassing any other machine in the world.

The Balize then removed back to her station, at the North East Pass, and proceeded to cut away a mud island, or lump, standing in the centre of the main channel, at the mouth of the Pass. The weather being stormy, the sea forced us to abandon the lump, after making several partial days work on it, and we then operated at the head of the bar proper, which extends five-eighths of a mile from the sea; this enabled us to work in smoother water. The bar being formed of alternate strata of sand and deposit from the river, making the bottom hard; and as the buckets were designed for soft mud, their size prevented their acting well—but with this disadvantage, 1500 cubic yards have been conveyed away by the hoppers, without extra exertions, in eight hours working.

On the 5th of March, we again moored alongside of the island which we previously worked on, and commenced working actively at it, when the sea would permit. The subduing it was necessarily a slow operation, its size being about 350 feet by 150, at its greatest breadth; the top being almost at the surface of the water, with nearly perpendicular sides. The dredge was a long time cutting at it with the buckets of one side before any mud could be raised by those of the other side, to be conveyed away by the hoppers.

On the 5th of April we had cut and removed nearly half of the lump down to thirteen feet water, the boat was then shifted to the north side of it, and on the 12th the dredger (drawing eight feet water)

\* That there may be no doubt of this, I will state that eight buckets were raised per minute.

$8 \times 1 \times 60 = 480$  cubic yards, even measure. The buckets being kept heaped, 600 yards is a safe estimate.

passed over the top of the lump, operating with both sides and filling two hoppers at the same time.

On the 17th of April, 1839, orders were received to stop dredging and lay the fleet up, the appropriation being expended. A few thousand dollars more would have removed this lump from the channel, as the smoothness of the sea at this season of the year admitted of nearly constant working—subsequently the fleet was ordered to Mobile and there laid up.

The principal difficulties encountered in our operations were, 1st, in placing the machinery from the want of correct knowledge of the bottom—for although several partial surveys had been made by different persons from 1820 down, and inquiries from shipmasters and others supposed to be conversant with the actual state of the bars, yet their reports left the impression that the north east bar was soft mud and easily removed; as this proved to be incorrect the consequence was that numerous alterations had to be made as experience pointed out.

2d. The operations being on the margin of the Gulf of Mexico, great loss of time was experienced from the prevalence of easterly gales, which blowing against the current of the river caused considerable sea, the depth of cutting being from thirteen to fifteen feet, the force of the sea had a great effect in deranging the machinery.

3rd. In conveying the mud away from the dredger often considerable time was lost by the hoppers not discharging their load (one hundred cubic yards) owing to the mass becoming compact.

A great loss of working time was also owing to the tow boat frequently getting aground and blundering in bringing the receiving vessels to, and taking them from, the dredger, all these, coupled with the general inexperience attending works of this kind and magnitude, and being distant over one hundred miles from the nearest work shops, prevented a successful beginning; but the latter part of the operation, owing to the perfection arising from practice, was highly successful, and will bear a comparison with any other dredging operation.

In connexion with the foregoing, I give you the mean of a number of experiments made with the engine at Mobile, during the month of June, 1839, these may be relied on as correct although differing from some of the theoretical properties of expansion. I was unable to give higher speeds to the wheels on account of bringing home the anchors, the boat being moored in the stream.

The horizontal cylinder is nineteen and one-eighth inches in diameter, and seven feet stroke, and works either by a whole stroke eccentric or a five-eighth cam, the exhaust either way being the whole stroke. Each wheel is of the double form, eighteen feet seven inches in diam-



eter; extreme length of the bucket six feet ten inches; each section has twelve buckets twenty-one inches deep.

The shaft has two fly wheels and couplings to admit of the engine being worked independent of the wheels.

The time for experimenting was chosen when there was little or no current, the engine being in perfect order, and working with little friction.

One pair of boilers were used, these being on the guard made the length of the steam pipe about thirteen feet, it and the cylinder being covered so as to lessen the radiation of heat. At the time of the experiments the boat had a list to port, which made the immersion of the starboard buckets two and a half inches, and the larboard ones seven inches. The pressure in the boilers being one and a half pounds to the square inch, the throttle valve being open (during the experiments,) and the whole stroke on, just kept the engine in motion, being equal to the friction.

| Pressure in the boiler, lbs. per square inch. | Steam as applied. | Revolutions per minute. | Remarks.                 |
|-----------------------------------------------|-------------------|-------------------------|--------------------------|
| 6                                             | Cam.              | 7.5                     | } Engine alone.          |
| 6                                             | Eccentric.        | 18.5                    |                          |
| 5                                             | Cam.              | None.                   |                          |
| 5                                             | Eccentric.        | 12                      |                          |
| 4.4                                           | "                 | Just move.              | Starboard wheel coupled. |
| 6.4                                           | "                 | "                       | Larboard.                |
| 10.4                                          | "                 | "                       | Both wheels.             |
| 13.5                                          | "                 | 3.3                     | "                        |
| 20.4                                          | Cam.              | Just move.              | "                        |
| 24.4                                          | "                 | 6                       | "                        |
| 24.4                                          | Eccentric.        | 9.5                     | "                        |

I also verified the experiments noted in this journal, to prove that the water displaced by steamboat wheels did not come from before them, I strewed the surface of the water with chaff and then set the wheels in motion, and found that six inches in front of the wheels the chaff floated undisturbed.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Extracts from the Annual Report of the Board of Canal Commissioners of the State of New York. Dated Albany, January 25th, 1841.*

The navigation of the canals was opened throughout all the lines on the 20th of April, and was closed on the 5th of December. Lake Erie was opened at Buffalo on the 27th of April.



During the thirteen years next preceding, the canals and the lake at Buffalo were respectively opened as follows:

|                     |             |          |             |
|---------------------|-------------|----------|-------------|
| In 1839, the canals | April 20th, | the lake | April 11th. |
| 1838, do.           | do. 12th,   | do.      | March 31st. |
| 1837, do.           | do. 20th,   | do.      | May 16th.   |
| 1836, do.           | do. 25th,   | do.      | April 27th. |
| 1835, do.           | do. 15th,   | do.      | May 8th.    |
| 1834, do.           | do. 17th,   | do.      | April 6th.  |
| 1833, do.           | do. 19th,   | do.      | do. 23rd.   |
| 1832, do.           | do. 25th,   | do.      | do. 27th.   |
| 1831, do.           | do. 16th,   | do.      | May 8th.    |
| 1830, do.           | do. 20th,   | do.      | April 6th.  |
| 1829, do.           | May 2nd,    | do.      | May 10th.   |
| 1828, do.           | March 27th, | do.      | April 1st.  |
| 1827, do.           | do. 21st,   | do.      | do. 21st.   |

With the exception of a breach, which took place at Schenectady, on the 29th of April, and which was repaired on the 6th of May, and some other less important interruptions which are hereafter stated, no casualties have occurred to suspend the navigation.

The commissioners of the Canal Fund, in their recent report to the Legislature, (Assembly documents, 1841, No. 5,) state that the gross amount of tolls received during the season of navigation,

|                                    |   |   |   |   |                 |
|------------------------------------|---|---|---|---|-----------------|
| Were                               | - | - | - | - | \$ 1,775,747.57 |
| And in 1839                        | - | - | - | - | 1,616,382.42    |
| Increase $9\frac{3}{16}$ per cent. |   |   |   |   | \$ 159,365.15   |

The amount which has been disbursed by the superintendents of repairs during the year ending January 1st, 1841, is \$412,979.48. The movement of property upon the Erie canal has been unusually active, especially in the latter part of the season, and more than ordinary efforts have been made to expedite the passage of boats. The sudden increase of business which was experienced upon the coming in of the western crops, and the unequal manner in which the trade is necessarily distributed through the season, caused considerable delay and pressure at the locks. During portions of the season the boats were so much retarded, that in some instances, the length of their trips to and from tide water, was increased four days.

To relieve the pressure, by enabling the forwarders as far as practicable, to augment their cargoes, the greatest volume of water was admitted into the canal which its banks were able to sustain, and it may be affirmed that in this respect the capacity of the canal was pushed

to the utmost limit compatible with safety. The increased facilities which have been thus afforded to the navigation, are shown by returns which have been obtained from the weigh-masters in charge of the five weigh locks on the Erie canal, to wit, two on the tide water at Albany and West Troy, and three at Utica, Syracuse, and Rochester. The ascending trade of the canal, which consists mainly of merchandise, having been comparatively inactive, the movement from the tide water has considerably diminished. The returns from the weigh-masters at Albany and West Troy, (where nearly all the ascending cargoes are weighed,) show that the number at those two offices was,

|                 |          |                      |            |
|-----------------|----------|----------------------|------------|
| In 1839, 6,739, | weighing | 181,271 tons—average | 26.6 tons. |
| 1840, 5,883,    | “        | 155,113 “ “          | 26.3 “     |

On the other hand the number weighed at Utica, Syracuse, and Rochester, (consisting almost exclusively of descending cargoes,) was,

|                 |          |                      |          |
|-----------------|----------|----------------------|----------|
| In 1839, 9,575, | weighing | 326,806 tons—average | 34 tons. |
| 1840, 9,625,    | “        | 407,847 “ “          | 42.3 “   |
|                 |          | <hr/>                | <hr/>    |
|                 |          | 81,041               | 8.3      |

showing an increase both in number and weight.

The greatest increase was at Rochester, where the cargoes,

|                      |          |                      |            |
|----------------------|----------|----------------------|------------|
| In 1839, were 3,974, | weighing | 115,507 tons—average | 29.0 tons. |
| 1840, “ 4,110,       | “        | 171,869 “ “          | 41.8 “     |

|          |   |   |              |
|----------|---|---|--------------|
| Increase | - | - | 56,362 tons. |
|----------|---|---|--------------|

The number of cargoes at Utica, Syracuse, and Rochester weighing upwards of 50 tons each, was,

|         |   |   |   |   |   |      |
|---------|---|---|---|---|---|------|
| In 1839 | - | - | - | - | - | 611  |
| In 1840 | - | - | - | - | - | 1801 |

Of the cargoes at Rochester, 75 exceeded 55 tons; 7 exceeded 60, and there were two of 66½ tons.

The commissioners have deemed these inquiries important, for the purpose not only of ascertaining the maximum capacity of the present canal as a channel of transportation, but also of exhibiting the advantages which may be expected from augmenting its depth to seven feet. The results fully confirm the opinions heretofore entertained, that the canal, when enlarged, will admit boats carrying cargoes from 150 to 200 tons.

The augmentation above stated to have taken place during the last season, in the weight of cargoes, has correspondingly lessened the number of boats which otherwise would have passed the locks. Fur-

ther relief possibly might be obtained by adopting regulations which should prescribe the minimum weight of the cargoes and distribute the trade more equally through the season, but they probably would occasion considerable dissatisfaction, and could be justified only by extreme necessity.

An account has been kept for several years by the lock tender at Alexander's lock, near Schenectady, of the boats passing that point. For the purpose of obtaining information still more authentic, the commissioners have caused the clearances of all the boats which passed that lock during the last season to be enumerated, from which it appears that the true number was 26,987; being an average of 117 for each of the 229 days of navigation, or one in every twelve minutes. The irregular distribution of trade has, however, crowded into the months of May and October so great a proportion that the lockages in those months were,

In May        3,895, being 125.6 daily, or 1 in 11.5 minutes.

In October, 4,156,    "    134.0    "    or 1 in 10.8    "

And this rate has been itself increased by casualties, which have interrupted the navigation during those months. In May last the suspension amounted to six days; and in October to one day; leaving for the remaining twenty-five days in May 155.4 daily, or 1 in 9.26 minutes; and for the remaining thirty days in October 138.5 daily, or 1 in 10.39 minutes. Deducting the days of suspension for the whole season, and excluding April and December, the number of lockages was 25,854 in 204 days; being 126.7 daily, or 1 in 11.36 minutes.

It is stated that in the month of June, 1836, 246 boats were passed at Alexander's lock in twenty-four hours, being one in every six minutes; but it is not to be expected that the locks on other levels less favourably situated in respect to their supply of water, will be able to maintain so rapid a rate. At some of them, where the point of supply is remote, it may be doubted whether more than 200 boats can be passed in the twenty-four hours, or one in seven minutes. The difficulties arise not so much from the inability of the lock to pass the boats as from the scanty capacity of the channel of the canal, which does not enable it to pass the water required. This difficulty will be aggravated as the boats shall increase in number, for they will accumulate more frequently and in larger masses in the channel of the canal, and no relief whatever will be afforded by doubling the locks without enlarging the channel. The breach above mentioned as taking place in April last, occurred near Alexander's lock, but so much was the level obstructed by the crowd of boats that only seventy-six could be passed on the day the breach was repaired; 119 on the



second day, 152 on the third, and 210 on the fourth, having gradually increased as the crowd was dispersed. At the breach which took place on the long level at Frankfort, in May, 1839, a crowd of boats more than ten miles in length was accumulated; and it was ten days after the breach was repaired before the navigation could be entirely relieved.

It is impossible wholly to guard against interruptions in the use of a work so defective as the present canal. Breaches will inevitably occur, and it must be expected that as the number of boats shall increase, approaching nearer and nearer to the maximum capacity of the canal, every interruption to the navigation, however slight, will be more and more sensibly felt. It may be confidently predicted that when the average number of the lockages shall rise as high as 200 daily, the canal will be so much obstructed that a portion of the trade will be compelled to seek some other avenue to market.

The number of lockages is governed exclusively by the quantity of tonnage which descends, and is not affected by that which ascends the canal. The weight transported from the interior to the tide water, greatly exceeds that which is carried from the tide water into the interior, being in the proportion of at least four to one, so that the same boats which bring down the descending tonnage are able to transport the return cargoes. Being obliged to return and to pass through the locks, whether loaded or empty, the ascending boats do not increase the number of lockages; but each descending boat necessarily makes two lockages, one on its way down and the other on its return.

From this view of the subject, it will be obvious that the question of the time when the maximum capacity of the canal will be reached, does not depend upon the rate at which the revenue may increase; for much of that increase may, and probably will, be derived from the ascending trade; nor does it depend upon the rate of increase in the value of the commodities brought down. An accession to the descending tonnage of 100,000 tons of lumber or coal, paying in tolls but \$60,000, will obstruct the navigation as effectually as the like quantity of flour or wheat, paying \$300,000. On the other hand, 200,000 tons of merchandise might be added to the ascending tonnage and pay in toll \$600,000 without obstructing the canal at all.

If the average weight of the descending cargoes be taken at 45 tons (and from the facts above stated that is rather above the true amount,) every 45,000 tons added to the present descending tonnage, will require 1000 boats, which will pass the locks once in descending and once in ascending, thus making 2000 lockages. If these should be distributed equally through the 228 days of navigation, they would produce a daily accession of  $9\frac{8}{10}$  lockages; but if the 45,000 tons



should, and it doubtless would, be distributed like the rest of the trade unequally through the season, the daily accessions which it would produce in the crowded months of May and October, would be correspondingly increased, swelling the number from  $9\frac{8}{10}$  to at least 11 daily. In the same proportion, an accession of 90,000 tons would increase the daily lockages to 22; 135,000 tons to 33; 180,000 to 44; and 225,000 tons to 55; which latter amount, added to the present daily average of 155 for October, carries the total beyond the maximum capacity of the canal.

The inquiry then is narrowed down to a single question; at what time is it probable that 225,000 tons will be added to the present descending tonnage of the Erie Canal? \* \* \* \* \*

It will be obvious that no means exist for fixing with much precision the period when this quantity will be added, liable as it is to be affected by the ever varying vicissitudes to which the commerce of the country is exposed.

That the time may arrive very speedily is not impossible, and indeed not very improbable; while on the other hand, causes similar to those which in the last few years have affected the business of the canals, may again produce similar effects. \* \* \* \* \*

## **Progress of Practical & Theoretical Mechanics & Chemistry.**

### *On the Power of Anthracite Coal for generating Steam.*

The number of the Edinburgh new Philosophical Journal for April, 1841, contains an article on the evaporative power of different kinds of coal, by Andrew Fyfe, M. D., F. R. S. E., President of the Society of Arts for Scotland; communicated by that Society. The whole of this interesting and valuable article is worthy of being re-printed in the Journal of the Franklin Institute, but, as want of space prevents this, the following extracts are inserted to show the conclusions to which Dr. Fyfe has arrived. It will be seen that, although the anthracite with which he experimented was of inferior quality, its evaporative power greatly exceeded that of good Scotch bituminous coal. The furnace was supplied with *heated air*. S. W. R.

The experiments, the results of which I am now to bring before the Society, were undertaken with the view of ascertaining the comparative evaporative power of different kinds of coal. Of course, in this investigation, my attention has been directed solely to the power of the fuels in raising steam, with the view of testing their comparative value for steam-engines.

If we suppose, as has been stated by Lardner and others, that it requires five and a half times as long to evaporate water that it does

to raise it from the freezing to the boiling point, then the latent heat will amount to 990. But others have made it lower than this. According to Despretz it is only 955.8. Assuming this as correct, then in steam the total number of degrees of temperature beyond 32 is  $(180 \times 955.8)$  1135.8—say 1136. Hence if one pound of carbon will raise 78.15 lb., as stated by Despretz, from 32 to 212, it will evaporate 12.3 lb. from 32—and this is the quantity fixed on by him.

It is well known that the different substances used as fuel consist, in their original state, chiefly of carbon and of hydrogen, in addition to which there is generally a minute quantity of oxygen and of nitrogen, and there is always a portion of earthy and metallic matter, constituting the ashes. The only one of these which, in addition to the carbon, will evolve heat during the combustion, is the hydrogen. Now one of hydrogen combines with eight of oxygen, or exactly three times as much as carbon requires. One pound of hydrogen will therefore evaporate 37 lb. of water from 32.

It is evident from this, that if we know the composition of the fuel, we can calculate the evaporative power by knowing the quantity of oxygen necessary for converting the carbon and hydrogen into carbonic acid and water. Of course, the greater the proportion of hydrogen, the greater ought the evaporative power to be. If the fuel contain nitrogen, a part of the hydrogen must be deducted from the whole quantity, because the nitrogen will unite with it to form ammonia; and, again, if oxygen exist in the fuel, the hydrogen which is requisite to convert that oxygen into water must also be deducted, and, accordingly, in addition to the carbon, it is only the hydrogen over and above what is required for uniting with the nitrogen and oxygen, that are to evolve heat by the combustion.

It is well known, however, that in burning fuel the combustion is rarely, if ever, perfect, and it never happens that the whole of the heat evolved is taken up by the water; as to the latter, there always is, indeed in the common way of consuming fuel there must be, a waste, which is necessary to keep up the draught; but in addition to this, much of the heat must also be lost by the ascending current of air, which in some furnaces is excessive, and of course the waste is enormous, frequently amounting to one-third, sometimes to one-half of that evolved. With regard to the imperfect combustion, much must depend on the nature of the fuel, and on the particular construction of the furnaces. Thus, when the fuel in common use is heated, it gives off gaseous inflammable matter, which, if it be brought in contact with air at the requisite temperature, will be inflamed; but if air be not present, or if there be a deficiency of it, then the greater part of the gas will escape without undergoing combustion, and hence the waste which, it may be said, occurs in every furnace constructed in the usual way. It has been supposed by some, that the combustion is perfect where there is no smoke, but this is by no means a proof that the whole of the inflammable is consumed; a part of the gaseous matter may be escaping in the state of hydro-carbon, or of carbonic oxide, without undergoing any action, and if so, it is just so much fuel wasted. It is evident then, that the *practical evaporative*

*power* must depend very much on the manner in which the combustion is effected, and also on the peculiar constitution of the coal; even when the combustion is as perfect as we can expect, still there may be a loss of heat from the generation of the gaseous materials; for when the carbon and hydrogen are evolved as hydro-carbons, they must absorb caloric to enable them to assume the gaseous form. Though we should naturally expect, therefore, that the heat evolved by those coals which contain much hydrogen should be greater than when little of it is present, this is not always the case; indeed we shall find that *the practical evaporative power is greatest when the fuel contains a great deal of fixed carbon*; for when the carbon is in that state, it must, before it can escape, combine with oxygen and thus be consumed, whereas, as already mentioned, the hydro-carbons may partly fly off without being burned.

From what has been said it is evident that the method proposed by Berthier is well adapted for ascertaining with ease the amount of heat that ought to be evolved by the combustion of a fuel; yet it does not indicate the available heat, in other words, what may be called the *evaporative power in practice*. The only method, I conceive, by which this can be done, is by actual combustion in properly constructed furnaces, and by measuring the quantity of water that is evaporated by the use of a given weight of the fuel, and we can then compare this with the quantity which carbon will evaporate, and which, as already stated, is, according to Despretz, 12.3 times its own weight from the temperature of thirty-two.

I am aware that to this method the objection may be urged, that as our furnaces are never so constructed as to effect complete combustion, and that as the combustion varies very much in different furnaces, the results ought not to be relied on. Now this is undoubtedly so far a valid objection; but if our trials are conducted with what will be allowed to be a furnace constructed on proper principles, and if the trials are made on the different fuels, making such adjustments and alterations as may be requisite for the fuel under use, then the results, though they do not give what ought to take place, yet give the comparative evaporative power in practice, and in this respect become extremely valuable, as pointing out the kind of fuel that is most beneficial for the purposes required.

With regard to the furnaces in which these trials were made, they were sometimes small, at other times and most frequently large, such as those attached to a four and ten-horse engine. In carrying on the experiments with one particular kind of fuel, I mean anthracite, it was necessary to have recourse to a peculiar construction of furnace, so as not only to secure the complete combustion of the coal, but also to try its power in raising steam rapidly, which, it is well known, is necessary when the fuel is to be used for steam-engine furnaces; and it is of the utmost consequence to keep this in view; for however great the evaporative power even in practice may be, that fuel is of little value if it cannot be burned so as to make it applicable for the purposes for which fuel is generally used, such as the rapid raising of steam, and keeping up a sufficient supply for the engine.



The experiments, the results of which I am first to detail, were made with the view of ascertaining the comparative practical evaporative power of anthracite and of Scotch coal. They were conducted with a furnace attached to a four-horse high-pressure boiler; the furnace bars, of which there were from twelve to fourteen, according to circumstances, were each three feet six inches in length, and in all two feet four inches in breadth, including the spaces between them, giving seven feet of fire surface. It was at first fitted up with flash-flues, which were afterwards changed to the common flue, eighteen inches by fourteen, passing along the boiler on one side, returning on the other, and then entering the chimney. The chimney-stalk was twenty-two inches by eighteen, and thirty-three feet in height, in addition to which an iron tube of a foot in diameter and twelve feet in height was attached, thus making the whole height forty-five feet. To this boiler and furnace there was attached an apparatus by which the fuel could, when required, be supplied with warm air. It consisted of a metallic box placed immediately beyond the end of the bars forming the floor of the furnace, from which there proceeded tubes that passed through the boiler, and so placed in it as to be surrounded by the water. From these, after passing through the front of the boiler, a large tube was transmitted to the ash-pit. A drain was carried from the side of the furnace to the box situated beyond the fire-bars to supply air, and the ash-pit was furnished with a door which fitted tight so as to prevent any current up through it. By this adjustment, when the ash-pit door was shut, the air for combustion was supplied through the box, heated to a considerable degree, and after passing through the tubes in the boiler, then proceeded to the ash-pit, and rushing up through the fuel kept up the combustion. By apertures left for the purpose and supplied with plugs, the temperature of the air passing into the ash-pit was ascertained.

The apparatus just described is that patented by Mr. Bell, with the view of increasing the heating surface exposed to the water in the boiler, and thus increasing the amount of evaporation. I do not, however, bring the experiments forward with the intention of proving the efficacy of this patent. It is not at all my intention to enter into its merits. I had recourse to this apparatus, merely as a means of enabling me to burn the anthracite, so as to make it subservient for the purpose of raising steam, and of keeping up the supply; and thus also to enable me to compare its practical evaporative power with that of bituminous coal.

*Scotch Coal.*—I conceive it unnecessary to give the result of the numerous trials made with this fuel. They, in general, come very near to each other. I give the particulars of one only, which was conducted with great care, and in the result of which the utmost confidence may be placed. The coal used was from Middlerig, and is considered of good quality.

In this trial the furnace was supplied with the cwt. of coal at three different stokings. The pressure on the boiler was seventeen pounds beyond the atmospheric pressure.

The table shows, that 784 lb. of fuel were used, and that 488 gal-



lons, that is 4880 lb. of water were evaporated from the temperature  $45^{\circ}$ , thus giving a result of 6.22 lb. for each pound of coal, at seventeen pounds pressure.

On subjecting the coal used in this trial to analysis, I found it to consist of—

|                  |   |   |   |   |       |
|------------------|---|---|---|---|-------|
| Moisture,        | - | - | - | - | 7.5   |
| Volatile matter, | - | - | - | - | 34.5  |
| Fixed carbon,    | - | - | - | - | 50.5  |
| Ashes,           | - | - | - | - | 7.5   |
|                  |   |   |   |   | <hr/> |
|                  |   |   |   |   | 100.0 |

By the test with litharge as proposed by Berthier, I found that the greatest quantity of oxygen required for the combustion of the fuel with which the first trial above given was made, was 205, which would make its evaporative power 9.48. But by the furnace trial only 6.22 were evaporated.

Now  $9.48 - 6.22 = 3.26$  and  $9.48 : 3.26 :: 100 : 34.38$ ; without taking into account the slight difference in temperature between  $32^{\circ}$  and  $45^{\circ}$ , there was therefore a loss of 34.38 per cent. of the heat supposed to be evolved, provided the whole of the fuel was consumed; but in this trial the cinders in the ash-pit amounted to fifty-two pounds, and deducting this from the fuel used, there were only 732 lb. actually consumed, which would make the evaporation amount to 6.66, and  $9.48 - 6.66 = 2.82$ , and  $9.48 : 2.82 :: 100 : 28.97$ ; thus giving a loss of 28.97 per cent. of the heat evolved, supposing 732 lb. of coal had undergone complete combustion.

*Anthracite.*—The anthracite coal with which my trials were made was much mixed, some parts being of good quality, others containing an admixture of impure coal, having a good deal of iron-pyrites and of earthy matter. In its composition it resembled the specimens analysed by Berthier. Its specific gravity varied from 1303.5 to 1406.6. To procure an average sample for analysis, a considerable quantity was taken from the heap at random, which was bruised, and from this a smaller quantity was removed and then reduced to powder. This, on analysis yielded

|                  |   |   |   |   |       |
|------------------|---|---|---|---|-------|
| Moisture,        | - | - | - | - | 4.5   |
| Volatile matter, | - | - | - | - | 13.3  |
| Fixed carbon,    | - | - | - | - | 71.4  |
| Ashes,           | - | - | - | - | 10.8  |
|                  |   |   |   |   | <hr/> |
|                  |   |   |   |   | 100.0 |

Anthracite of good quality burns with very little or no flame, and without smoke. When first thrown on the fire it decrepitates, and small pieces are thrown off from it, which choke up the spaces between the fire bars, and also the flues, and in a great measure prevent the combustion from going on. Though it can be burned in common grates, yet, unless consumed in some particular way, it does not answer well for raising steam, owing to the slowness of the combustion.

A patent was lately taken out by Mr. Player for effecting the consumption of anthracite, by previously heating the coal, by making the part of the apparatus containing the fuel to be supplied to the furnace, pass through the boiler, by which means it derives heat from the water. *The method I adopted was to supply the coal with air previously warmed*, which was done by making it traverse the apparatus already described, and by which the temperature was on an average about  $350^{\circ}$ . By this contrivance, the decrepitation was almost entirely prevented, the combustion was rapid, and the steam was easily kept up. I have already mentioned that the anthracite I employed was of inferior quality; it contained not only a large quantity of ash, but also of volatile matter, the latter of which made it burn with flame, while the former, owing to the intense heat generated, formed a tough slag, which adhered firmly to the bars, and in a great measure retarded the combustion.

It is unnecessary to state the result of the numerous trials made after having satisfied myself that I had effected completely the combustion of the fuel. I will confine my remarks to one only, performed when the furnace was in good working condition, the pressure on the boiler being seventeen pounds. It was continued from ten in the morning till half after six in the evening.

In this trial the total quantity of coal used was 448 lb., and the evaporation amounted to 3560 lb.; there were therefore evaporated 7.94 lbs. for each pound of coal. The evaporative power of this anthracite, when tried by the litharge test, was found to be 10.78, compared to that of carbon as 12.3.

Now  $10.78 - 7.94 = 2.84$ , and  $10.78 : 2.84 :: 100 : 26.34$ ; there was therefore a loss of 26.34 per cent., supposing the whole of the coal thrown into the furnace was consumed. The coal found in the ash-pit was 40.5 lb., thus making the quantity actually consumed amount to 407.5, which would make the evaporation 8.73 for each pound of coal undergoing combustion. The evaporative power of this fuel, it has been already stated, as tried by the litharge test, was 10.78.

Now  $10.78 - 8.73 = 2.05$ , and  $10.78 : 2.05 :: 100 : 19$ ; there was therefore a loss of 19 per cent. of the total heat evolved, supposing the  $407\frac{1}{2}$  lb. fuel consumed to have undergone complete combustion. With the Scotch coal the loss amounted to 28.97 per cent.

On viewing the results of the experiments now detailed, one remarkable circumstance at once strikes us,—it is the great practical evaporative power of anthracite over the other kinds of coal, which, though they contain less fixed carbon, yet have much more volatile matter, the hydrogen of which, I have already said, gives out thrice as much heat as carbon does. In the anthracite which I employed, the fixed carbon amounted to 71.4 per cent., in the caking coal it was 67, and in the Scotch coal only 50.5. Now, with regard to the comparative practical evaporative power of the Scotch and English coal, I have stated them as 100 to 133, and as  $50.5 : 67 :: 100 : 132$ .

Again, with regard to the Scotch and anthracite, I have given the evaporative power as  $6.66$  to  $8.73$ , and  $50.5 : 71.4 :: 6.66 : 9.41$ . Thus, *not only is the evaporative power in practice in the ratio of the*

*fixed carbon, but there is a very remarkable approximation in the evaporative power to the proportion of this ingredient in each.*

In the anthracite the volatile matter, independent of the moisture, was 13.3, in the English it was 29.5, and in the Scotch it amounted to no less than 34.5 per cent. We would therefore naturally expect that the English and Scotch coal would have a greater evaporative power, whereas that which has the least of these volatile ingredients has the greatest. It is evident from this, that, in the combustion of fuel in furnaces as commonly constructed, the loss of the heat evolved is occasioned in a great measure by the volatile matter; much of these we know is consumed, but even in the best constructed furnaces, there is an escape of a considerable proportion, owing to the want of a due supply of air, or from want of the proper temperature even though air is present; indeed it is chiefly owing to the latter, for we never find that the air that has passed up through the fuel is entirely deprived of its oxygen.

There is still another point to which I wish to advert. I have already alluded to the great practical evaporative power of those fuels containing much fixed carbon. On still farther viewing the results of the experiments which have been detailed, we find that not only does the evaporative power bear a ratio to the proportion of this element in the different fuels, but it would appear to be almost in the exact ratio of its quantity in each. Thus the fixed carbon in the anthracite I employed was 71.4 per cent.—now, taking that of pure carbon as 12.3

as  $100 : 12.3 :: 71.4 : 8.77$ ,

the practical working of the fuel actually consumed was 8.73. The fixed carbon in the Scotch coal was 50.5 per cent. and

as  $100 : 12.3 :: 50.5 : 6.21$ ,

the practical working was 6.66. In the anthracite used by Dr. Schafhaeutl, the fixed carbon was 92.42,

and as  $100 : 12.3 :: 92.42 : 11.36$ ,

the practical working was 10.56. The evaporative power in practice seems therefore to be very nearly as the quantity of fixed carbon in the fuel. I am strongly inclined to think that this will be found to be the case with all fuels in their natural state; and if so, then in using fuel in furnaces as now constructed, supposing the combustion to be as perfect as we can expect to make it in these furnaces, we shall find the practical evaporative power to be according to the per-centage of fixed carbon.

Whether or not it is found that the practical evaporative power is as the fixed carbon, it must be allowed that in the trials, the results of which I have given, it bears a close approximation to it;—then a question arises, What becomes of the heat evolved by the combustion of the volatile ingredients? We know that the greater part of these is consumed, and they must give out heat by their combustion; if so, how does it happen that the evaporation is not greater than what should be occasioned by the consumption merely of the fixed carbon? This may, to a certain extent, be explained by the volatilization of the elements that assume the gaseous form. When heat is applied



to coal, by which it is made to unite with oxygen and itself give forth heat, a part of that heat must be spent in enabling the hydrogen, with the equivalent proportion of carbon, to assume the elastic form. Now, if the whole of this was to escape without undergoing combustion, while, at the same time, the fixed carbon only is burned, we can easily conceive that the evaporative power of a coal thus consumed, would be less than in the ratio of the fixed carbon it contains; but this is never the case in properly constructed furnaces; a great part of the gaseous matters is consumed, and they, by their combustion, again evolve the heat which was absorbed by them when assuming the elastic form. Perhaps in furnaces as now constructed, even on the best principles, the whole, or nearly the whole, of the heat thus disengaged is so required; of course, the greater the proportion of volatile matter, the greater will be the abstraction of heat while they become gaseous, and, consequently, it will require the consumption of a proportional part to supply the heat thus abstracted. While, therefore, the heat evolved by the combustion of the fixed carbon is a fixed quantity in each fuel, and as, when the gaseous matter evolved is great, a proportionally smaller quantity of it is generally consumed, hence the lower evaporative power of those fuels containing much of the elements that yield the volatile matter; and, again, as it is much easier to effect the complete combustion of fixed carbon than of all the ingredients, both fixed and volatile, of a bituminous coal, hence the value of those that contain much of the fixed element, when consumed in furnaces as now usually constructed. I know that what I now assert is at variance with the opinions entertained on this point by practical engineers, who generally think that a great deal depends on the flame of the volatile matter. If, however, any reliance is to be placed in the experiments the results of which I have detailed, I think they will be forced to allow that I am correct in what I assert: that the greater the proportion of fixed carbon in a fuel, the greater will be the practical evaporative power. In a national point of view, then, now that the demand for fuel has become so great, and that for long voyages it is of the utmost consequence to have the fuel powerful, so as to occupy as little space as possible, or rather, if I may be allowed the expression, to have a greater quantity of an evaporative power stowed away in the same space, it is of vast importance that attempts should be made to introduce the anthracite fuel.

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*Memoir on the Preservation of Timber. By M. A. BOUCHERIE, M. D.*

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The development of industry in France, and the creation of new ways of communication, have considerably increased the consumption of timber in our country; on the other hand during twenty-five years of peace, the increase of the population has necessitated the giving to agriculture lands which were before occupied by forests.

Thus, whilst the employment of wood is increasing immeasurably, the production of it is every day more restrained, and the consequent

want of equilibrium must of necessity lead to an increasing elevation of the price, which is already attracting attention. In fact what are the bridges, canals, or railroads, already constructed, compared with those the necessity of which is daily proved to us? What is our merchant navy compared with those of England and the United States. The future then shows us the probability of the increased consumption of timber, and the probabilities of a supply are diminished by the perseverance with which our agricultural population continue to clear their lands: and yet France is even now unable to supply her own wants. The customs prove that of late the annual importation of foreign woods has exceeded the amount of thirty millions of francs, (\$ 6,000,000.) These considerations, already of such importance, and so worthy of serious examination, assume additional interest when we consider the rapidity with which timber decays in use, and the extreme slowness of its reproduction.

Upon the sea, according to the documents of the English Admiralty, a ship lasts fourteen years in time of peace, and eight in time of war. On land, we know with what rapidity wood rots in low and damp places.

For some time, an insect, the termites, has attracted particular attention on account of damage caused by them in constructions of wood. In the ports of Rochelle and Rochefort its propagation is so rapid that in a short time all the works which it attacks are destroyed. A member of the Academy, commissioned by the Minister of Commerce to examine these facts, admits that the importance of the ravages made by this insect has not been exaggerated; and to cite an example, under ordinary circumstances, and one which may be easily verified, the timber employed in the construction of the galleries of the Jardin des Plantes, is already in parts worm-eaten, and the galleries are not yet finished.

Thus a very few years suffices to destroy wood, the formation of which has perhaps required more than a century.

By all these incontestable facts, is shown the necessity, every day more pressing, of arriving at the discovery of some mode of preserving timber, so as to establish an equilibrium between its production and consumption. In England they have occupied themselves seriously with this work, and numerous patents prove the efforts made to arrive at the results of which I speak, while the registers of the Admiralty prove the interest with which it has constantly regarded these researches, hitherto so fruitless. Some attempts made lately in France, have been attended with no better success.

All these efforts have, however, not been without use; in the solution of the great problem, they have prepared the way for more fortunate studies, and it is but just to give due credit to their authors; but I believe that I may be permitted to say that the question has not been completely solved, and that no one has as yet arrived at a result in all respects satisfactory.

In order to the more easy appreciation of my labours, I will briefly state the attempts made up to this time. These statistics of our former knowledge upon the subject, will allow us to judge more correctly

of the particular character of my studies, and to appreciate the peculiar importance of the results which I have obtained. The researches, which have had for their object the preservation of timber, may be divided into two general and very distinct classes:—

In the first, have been principally studied the best conditions of the season for cutting the wood, in order to preserve it; the most efficacious way of rapidly drying it, and the means of preserving it from alteration whilst drying. Hygeinic researches, (if I may call them so) have also been undertaken for the purpose of preserving wood used in constructions, and a proper system of ventilation is one of the means from which the best results have been obtained. We may cite, among other good effects, those which have been obtained from it on board of vessels, the durability of which is remarkably increased by it, as well as the health of the crew.

In the second class, are ranked the efforts which have been made to arrive at the discovery of different agents, the application of which to the surface of the woods, or their introduction more or less deep into its substance, might protect them from every species of alteration to which they are exposed.

It is not necessary that I should occupy myself with the first branch of these experiments, in which moreover, I believe results have been obtained as perfect as can be hoped for. I wish to recal only those results obtained either by the application of coats of different kinds, or by the penetration of certain chemical reagents, whose protective power has been considered infallible. The processes employed for coating or penetrating wood, have been but few, the reagents proposed have, on the other hand, been numerous.

Different coatings of fatty or resinous matters are the most ancient methods of preservation. The surface of the wood was covered with them to prevent the contact of the air, which is the most active agent of their destruction, whether as being indispensable to the fermentations which manifest themselves, or as the vehicle by means of which the germs of animals are transported into their substance.

These means of preservation, as may be easily conceived, and as experience proves, are of an essentially perishable character; the coating is gradually detached, and moreover it does not destroy the cause of internal fermentation; although employed from the most ancient times, these coatings have been in our own time the objects of new researches, but as the result has only been to change the substances employed without any positive advantage, it seems to me useless to recapitulate the different experiments which have been made in this way.

Very recently it has been proposed to coat with a coating of hydraulic lime; it seems that this method has given good results, but it is expensive. It is only within the last fifty years that chemical reagents have been proposed for the preservation of wood, and the number of these to which is attributed the power of preventing all decay is considerable. The following is an enumeration of them, extracted from a memoir by John Knowles, translated into French,



and inserted in the 12th volume of the *Annales Maritimes et Coloniales*, by order of the Minister of the Navy:—

|                        |                     |
|------------------------|---------------------|
| Sulphate of Copper,    | Carbonate of Soda,  |
| “ Iron,                | “ Potassa,          |
| “ Zinc,                | “ Baryta,           |
| “ Lime,                | Sulphuric Acid,     |
| “ Magnesia,            | Muriate of Soda,    |
| “ Baryta,              | Quick Lime,         |
| “ Alumina and Potassa, | Nitrate of Potassa, |
| “ Soda,                | Arsenious Acid,     |

Deutochloride of Mercury (Corrosive Sublimate.)

Since the publication of Mr. Knowles' Essay, two other agents have been proposed and used, Oil and Kreosote. The slightest knowledge of chemistry will enable us to see that the greater number of these substances have been chosen by persons ignorant of their nature, and incapable of appreciating the reactions which they might produce upon the elements of the wood.

Thus, without speaking of insoluble bodies which are evidently useless, I will remark that all the sulphates proposed, except those of a soluble base, are decomposed by the wood, a part of the substance of which combines with their oxide, forming an insoluble compound, whilst the sulphuric acid, freed in the midst of the woody mass, acts upon it, as a corrosive, alters its nature rapidly, and causes it to pass into a substance much resembling carbon.

As to the sulphates with soluble bases, we can only conceive of their action by means of the changes which they effect in the liability to alteration of the sap, by mixing with it, and all known facts lead us to admit, that wood thus salted, especially with concentrated solutions, undergoes much more slowly those alterations which destroy it.

These remarks apply equally to the muriate of soda and the nitrate of potassa.

As to sulphuric acid and the carbonates of soda and potassa, it is difficult to conceive that they should have been proposed as preservative means. For it would be difficult to select more active agents of decomposition. The hopes to be entertained from the employment of arsenious acid and the deutochloride of mercury remain to be examined.

The property of volatility which the first of these bodies presents, forbids us to make use of it, even if we should be certain to prevent decay by means of it, a fact not yet ascertained, the accidents caused by its poisonous properties having forced them to abandon the experiments.

As to the corrosive sublimate, the preservative qualities of which have been justly celebrated, and upon which recent experiments made by Mr. Kyan in England, have again fixed attention; there is no doubt it is a preservative of great power, but the question of economy, which is inseparable from that of preservation, opposes imperatively the use of this substance, the price of corrosive sublimate, already very great, would be much raised by this new application, and would give to wood a price unfitting it for general use.

Moreover, the method always employed to introduce into the wood these different solutions, consisted in leaving them for a greater or less time, immersed in the solution, more or less dilute. In proceeding thus, we never attain more than an imperfect penetration, for it requires years to saturate heavy pieces of timber, with water alone.

Two new means for the preservation of timber have been proposed for public attention, since the publication of Mr. Knowles' memoir; the one is due to M. Breant, an officer of the mint, the other to M. Moll, a German mechanic.

The invention of M. Breant consists essentially of a very ingenious machine, which, acting by pressure, causes the liquid to penetrate through all parts of masses of timber of great diameter and length. A report of the Society for the Encouragement of National Industry has confirmed the good results obtained from this apparatus, and of its efficacy we cannot doubt. We may regard M. Breant therefore, as having solved the problem of penetration, as far as science is concerned, but the question of its practical application appears to me to remain untouched as to its principal point, that of economy. In fact in the employment of this means, we must consider not only the higher price of the machine, as a preliminary advance of capital, but also the great expense of maintaining it, and the inevitable repairs. It is hard to conceive that the price of timber would not thus become too great. The process of M. Moll is less known; it consists in introducing into the wood, kreosote in the state of vapour. I have not been able to procure any sufficient information on the subject of this invention, but I am disposed to believe, from the price of kreosote, that it does not solve the question of practical application.

Such was the state of our knowledge upon this subject when I commenced my study of it. Scarcely had the idea which is the foundation of my invention occurred to me, scarcely had a few experiments demonstrated its importance, when the circle of my observations immediately expanded.

Reflection caused me to foresee results of equally great importance with the preservation from wet and dry rot. Entering into the vast field of the arts which are affected by the employment of wood, I inquired of each manufacturer what was requisite in his especial department; while the preservation of the timber was necessary in all cases, sometimes it was necessary to give to certain kinds of wood a flexibility which they had not; in other cases the qualities of hardness, and immobility, and in almost all cases incombustibility were required.

Thus it was, that I embraced in my experiments a series of labours which I am about to submit to the Academy, and which have led me, I believe, to the discovery of efficacious processes.

1st. To protect wood against wet and dry rot.

2nd. To increase its hardness.

3rd. To preserve and develop its flexibility and elasticity.

4th. To render impossible, the play which it experiences, and the fractures consequent upon it, when, after being worked up, it is exposed to atmospheric variation.

5th. To reduce considerably its inflammability and combustibility.

6th. To give to it varied and permanent colors and odours.

Each of these important qualities which I have just mentioned, and upon which my experiments were directed, will be the subject of a chapter of this memoir.

It is only after two years devoted to this work that I presume to speak of it before the Academy. The new route which I have taken appears to me fertile in useful results. I do not pretend to have explored them all, and more skilful persons than myself will find in them matters for varied and important courses of experiments, but I have at least opened them up for their activity, and have traced the route for them. Perhaps, deeply impressed by the facts which I have observed, I may chance to hazard opinions little in harmony with those generally admitted. When truths come to light, they have to combat the errors which they are destined to replace, and if I have used a certain boldness in the exposition of my new ideas, it has not been done without an useful intention. Discussion brings light, and if I have committed errors they will justify themselves, as inseparable from that condition of novelty which marks the route in which I have traveled.

Moreover, it is not my intention at present, to speak of anything except the practical application of the results. Hereafter, if the Academy is kind enough to encourage this first communication, and thinks it worthy of interest, I will endeavour to unite in one work the materials which I have already collected; I will continue my efforts to complete them, as far as it is in my power to do so, and I will present myself again before them, as at present, to request their judgment and perhaps to merit their approbation.

[TO BE CONTINUED.]

*Report made by M. PAYEN, in the name of a special committee, on  
M. BREANT's method for the Preservation of Wood.*

[Translated for the Journal of the Franklin Institute.]

This process, (which dates from 1831) consists in impregnating wood with different solutions, by immersing the pieces in cylinders filled with the solution, and bringing a heavy pressure to bear upon the liquid.

The penetration is so perfect that even oily liquids reach the interior of the vegetable cells. Thus, in this regard, the efficacy of the process is evident; it is probable that the exceedingly condensed parts, such as the knots and heart of certain woods, which resist absorption by this means, will not be reached by any other process.

On the other hand it may be conceived, that the portions of the wood which have been rendered porous by decay, are easily filled with the solutions which are intended to preserve them from further injury. This may be judged of from a specimen in which the rotting has been arrested ever since 1834. In reference to the economy of the process, we shall soon be capable of judging, M. Breant having promised to place at our disposal the cast-iron cylinder and forcing pump, which he has used in his experiments.



It may be applied to causing the penetration of wood by oily and resinous solutions, which have not, to our knowledge, been used by the authors of the other processes.

But the first and most important condition which must be satisfied by the process, is to furnish pieces of wood which should resist decomposition, under circumstances in which the original wood would be injured. In reference to this point a decisive experiment has been made and recorded.

Deal plank, two inches in thickness, some of which were impregnated with flaxseed oil, and others left in their natural state, were placed at the same time upon the bridge Louis Philippe in 1834.

At the present time, that portion of the flooring of the bridge which was of ordinary wood has been so far decayed as to require entire renewal. The parts formed of the wood prepared by oil are hard, sonorous, free from all alteration, and seem to be in the same state as when laid, six years ago. This may be judged of, by remarking the perfect tightness of the nails driven into the wood. Two of these planks prepared by oil have been taken from the bridge and preserved by us, the others remain for the purpose of making future observations.

Bulletin de la Société, Jan. 1841.

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*On an unoxydizable Metal for Castings, or White Brass.* By  
M. SOREL.

[Translated for the Journal of the Franklin Institute.]

This alloy has the fracture and aspect of ordinary zinc, but possesses remarkable properties which will render it valuable in the arts. It is as hard as copper or iron; it possesses more tenacity than soft brass castings; it may be turned, filed, or bored, as well as those metals; it does not adhere to the metallic moulds in which it is run, and may be kept in moist air without rusting, or in the least losing its metallic lustre. Such an alloy will be of great utility in the manufacture of machinery, and as, moreover, it takes with great facility any of the bronze colours which it may be desired to give it, either by covering it with metallic precipitates, or by developing the copper which it contains, it will be eminently suitable to be employed in casting statues, vases, and other objects designed to ornament public monuments exposed in the open air. It will have, moreover, the advantage over bronze, of costing less.

It is prepared by casting together with proper precautions, zinc, copper, and cast-iron. It contains 10 p. ct. of copper, and 10 p. ct. of iron.

(Annales des Mines—Mai—June, 1840.)

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*Abstract of a Lecture on the Continental Method of Assaying Copper Ores.* By MR. S. H. THOMAS, formerly of Gwennap, but recently of the Allen Mines, Norway.

The Swedish and Norwegian method of assaying copper ore, as employed at the School of Mines at Fahleen, is in the humid way,

with sulphuric acid; it has been adopted in Germany, and lately introduced into some parts of England, and is performed in the following manner:—

The ore, after being thoroughly dried, is first pounded in an iron mortar, and afterwards reduced to an almost impalpable powder in a calcedony or agate mortar, and, after being well mixed, 100 grains are to be weighed and carefully placed in a digesting flask, with a short wide neck; about three-quarters of an ounce of concentrated sulphuric acid is next to be poured on the ore, and the whole digested on a sand bath, with a heat sufficient to boil the acid, and continued till all vapours from the acid disappear, and the mass becomes dry. Should any of the ore remain undigested, which may be easily distinguished in the bottom of the flask, a small quantity of the pure acid must again be added, and the process conducted as before. From twelve to twenty-four hours are necessary to evaporate the assay to perfect dryness; this, however, will depend upon the quantity of acid used, for if in excess the evaporation will be completed with great difficulty. Care must also be taken to keep up the fire throughout the process, and more particularly so at the close, for, in case it diminishes, the highly concentrated acid, from its great affinity for water, will absorb humidity so rapidly from the atmosphere, that in a short time the bulk of the solution will be almost equal to the acid at first introduced, and nearly as much time will be required for its evaporation to perfect dryness.

When the ore has been perfectly digested, and forms a dry mass, fifteen or twenty drops of acid are added, and, after being again digested for about half an hour, the whole is to be washed out in pure hot water, and afterwards rinsed on an evaporating dish. While the solution is hot, it is filtered into a large precipitating glass, made of equal thickness throughout to enable it the better to withstand the heat; the residue on the filter is to be washed with hot water until the droppings cease to change the colour of litmus paper; the solution in the glass should be perfectly transparent, of a greenish, bluish, or deep greenish-blue colour, according to the richness of the ore.

The glass containing the filtered solution is next placed on a sand bath in a moderate heat, and a small square bar of polished iron inserted, when an escape of hydrogen gas will immediately take place, and the copper will be precipitated in a metallic state. When the solution has become quite colourless, and the precipitation completed, the liquor is to be decanted, and the precipitate washed in clean hot water, slightly acidulated with sulphuric acid, by which any particles of sulphate of iron which might have been precipitated with the copper may be separated. The copper is next collected on a filter, the weight of which has been previously determined; it is then dried and weighed as quickly as possible, and the weight of the filter being deducted from the weight of the paper and copper, will leave the percentage of copper contained in the ore. A silver evaporating dish is recommended in preference to the filter, as the copper in this manner may be evaporated to dryness in a much shorter time than could be done with a filter, and it is not so subject to oxidation.

The following method of collecting and refining the copper, as practised at the School of Mines at Freyberg, in Saxony, will be found to differ very materially in almost all the processes, from the foregoing, and also from anything at present employed in England. Mr. Thomas believes the docimastic assay is pretty general throughout Germany, but the humid assay is frequently used and recommended in preference to any other.

The construction of the furnace employed at Freyberg differs from that of our common air furnace; it is made in precisely the same manner as our muffle furnace for the cupellation of silver. A muffle is placed in the centre of the furnace, and the heat is regulated by dampers and doors fixed in the different parts of the fire-place and ash-pit. The calcining crucible is formed in the shape of a cupel or test, made very flat, of a very pure kind of fire-clay, and with a shallow concavity on the upper part for the reception of the ore.

One hundred grains of pulverized ore are to be mixed with an equal bulk of charcoal powder, and placed in the shallow calcining crucible in the muffle; the heat of the furnace is gradually increased until all sulphurous or other fumes cease to rise, but not to such a degree as to fuse the ore, or make it stick to the bottom of the crucible. When all vapours have apparently ceased to be emitted, the crucible is removed from the muffle, and the assay carefully turned in such a manner, that, by replacing it, that part which before was undermost shall now be upwards, and exposed to the action of the atmospherical current of air passing through the muffle. When the ore has been sufficiently roasted on both sides, the crucible is again removed from the fire, and, when almost cold, the ore is to be mixed a second time with charcoal powder, in an agate or calcedony mortar; it is again subjected to the same process of calcination as before, and at its close the fire is increased to a strong red heat, to ensure the reduction of all sulphates, and the absence of the sulphurets, either of which being present in the after processes, would render the result inaccurate.

When the calcination is complete, and the assay rendered free from all volatile matter, it is taken from the fire and allowed to cool, and afterwards mixed with about thrice its weight of black flux, and 10 per cent. of granulated assay lead, and afterwards fused in a covered crucible in a strong white heat. The lead, from its affinity for copper, readily combines with the small particles of revived metal diffused in the slag, and, from its greater fusibility and specific gravity, easily subsides and separates from the earthy matter and other impurities. When the assay is sufficiently melted, and after being allowed to cool, on breaking the crucible the button of lead and copper will be found at the bottom.

During the time the assay is melting in the air furnace, a cupel or test, made of very fine and pure fire-clay, of a smaller size and less concavity than the calcining crucible, is placed in the muffle and subjected to a full white heat, after which the alloy of lead and copper is placed on it and tested in precisely the same manner as a silver assay. This process, however, requires much care and address, for



the instant the lead is completely oxidized and separated from the copper, the cupel is to be removed, and together with its contents, immersed in a basin of cold water ready at hand for that purpose. The sudden cooling prevents the lead from acting on and dissolving any part of the copper. In this manner, after considerable practice, very small portions of copper may be extracted from the ores, and it is on the same principle that the assay with the blowpipe is conducted, the only difference being in the separation of the lead from the copper by boracic acid.

To ensure an accurate result with the blowpipe, it was necessary that the substance should be eight or ten times as much as the assay; it should be reduced to an almost impalpable powder in an agate or calcedony mortar, and well dried previous to weighing. Care must be taken at the same time that the heat be not sufficient to calcine the ore or drive off the volatile substances, such as sulphur, arsenic, &c.; it should never be raised higher than that required to evaporate the aqueous particles. The assay of copper with the blowpipe is divided into two classes, viz:—Such as have the component parts volatile, or in which the copper in the state of an oxide is vitrified, or otherwise combined with earthy matter; and metallic combinations in which copper forms the principal, or only a small part of the whole. To the first belong the greater part of the ores of copper, and minerals containing this metal, and also the products of smelting-houses; and to the second metallic alloys, of all kinds, in which copper forms a component part.

As all substances ranked under the first class require roasting or calcining, 100 milligrammes (about one and a half grain,) must be placed in an agate mortar, and carefully mixed with three times its volume of pulverized pure charcoal, or with twenty milligrammes or twenty-five milligrammes of graphite—the latter, in most cases, being better for arsenical ores. This mixture is next placed in a shallow calcining crucible, prepared on the inside with red chalk, and the crucible is supported in a large deep hole, bored for the purpose in the charcoal, by the platinum wire and foil belonging to the blowpipe furnace or charcoal holder. For the purpose of calcination, a jet of large aperture is used with the blowpipe, and a strong oxidating flame is directed to that part of the charcoal immediately under the platinum support on which the crucible containing the ore is placed; care, however, must be taken that the heat be not sufficient to melt the ore. When the sample has been subjected to the calcination for some time, and the charcoal is burnt away from the upper part, it forms a hardish mass. The crucible is taken from the support, and with the assistance of a small spatula, the ore is turned over so that the bottom part may also be exposed to the air. To ensure the absence of arsenic and sulphur it is again mixed with charcoal dust and exposed to a strong red heat, after which it may be considered as perfectly calcined. The calcined ore being now composed of the oxide of copper, with other metallic oxides and earthy matter, it is to be mixed with 100 milligrammes of soda, and fifty milligrammes of borax glass. The soda is employed for reducing the oxide of copper,

and other metallic oxides easily reduced, and the borax glass for dissolving the difficultly reducible oxides, such as iron, manganese, and cobalt, as well as the earthy matter. The ore, after being well mixed with the flux, is inclosed in soda paper, and melted in a small hole made for that purpose in a piece of well burnt charcoal in the reducing flame, until all the copper is collected in a bead, and the other oxides, together with the earthy matter, form a fusible slag. If on breaking the slag the copper be found of a grey colour, it is a proof that the calcination was not perfect, and in this case it will be necessary to re-melt it with fifty milligrammes of granulated assay lead, and a little borax and soda mixed together, in a small hole on the charcoal with the reducing flame, until the copper combines with the lead and the soda, and the borax forms a clear glass bead. When this substance is sufficiently melted and cooled, the cupreous lead is to be separated from the slag and treated in the same manner as a metallic alloy.

In all combinations of copper with earths, such as silicates, and many other varieties, and when the copper averages about 30 per cent., it is necessary to add about fifty milligrammes of lead to the other fluxes; the lead combines with the copper, and prevents any mechanical loss that might otherwise occur in the slag. Fifteen or twenty milligrammes of oxide of antimony may be used instead of the lead; this metal reduces with the copper, and may afterwards be easily sublimed, leaving the copper pure. Metallic combinations, in which copper is a component part, is one of the most complicated of copper assays. It has been found that copper is easily separated from lead by melting the combination with boracic acid on charcoal—the lead is oxidized and dissolved, and the copper remains pure. Should a small portion of the copper be oxidized, and also be dissolved by the acid, it may again be easily reduced. If the copper or lead contain a small quantity of oxidizable metals, they are separated with the lead. On this account all combinations of lead and copper, with small portions of other easily oxidizable metals, are easily and accurately assayed by the blowpipe with boracic acid. Alloys of copper and antimony, or copper and tin, must be treated in a different manner.

An alloy of copper and lead is thus separated:—About an equal weight of boracic acid must first be melted to a bead alone, on the charcoal, the assay is afterwards added, and covered with a good reducing flame. Should the boracic acid become very fusible, and cover the metal, the blowpipe must be inserted deeper in the flame, and a fine blue point brought to act on the globule, so that the metal may be kept on the surface of the acid, in conjunction with the charcoal; one part will thus be acted on with the acid, and the other by the coal. By this means the lead shortly oxidizes through the action of atmospheric air, and is dissolved by the acid, leaving the copper pure. This process must be continued uninterruptedly until the lead is completely oxidized and the copper refined, which will be perceived from the greenish-blue colour it assumes when melting; the moment this change is observed, the flame is to be directed to the glass, by which the oxide of lead is slowly separated. When the

bead of copper has assumed a peculiar greenish-blue colour, the heat is discontinued, and the copper removed from the slag with the pincers, and when cold its properties may be investigated.

Of all the different modes of assaying copper ore with which the lecturer was acquainted, excepting that in the humid way with sulphuric acid, he must certainly give the preference to that at present used in Cornwall, which, although still very imperfect, is the most expeditious, and more to be depended on than either of the others. The German assay with lead comes next, but this requires both a practised eye and considerable address, to detect when the copper is sufficiently fine and the lead perfectly oxidized, without dissolving any of the copper. The French assay, as well as many of those employed in other parts of England, must necessarily be imperfect, for the great portion of earthy matter and metallic oxides in combination with the calcined ore, must render the slag thick or pasty, and the copper can only be reduced in part and collected, the remainder being dispersed throughout as well as in combination with the slag. The great advantage the Cornish assay possesses over the others consists in the first process of concentrating the copper, or, as it is termed, in making the regulus. All the earthy matter, and most of the metallic oxides, are in this process separated from the copper, which, combining with a portion of the sulphur, is obtained in an almost pure state, being alloyed only with a small quantity of iron, which is easily separated in the subsequent processes. The humid assay with sulphuric acid is the most correct, but the process is long and tedious; it requires a great deal of care and attention, and much skill and practice are necessary to ensure an accurate result. In precipitating the copper from its solution with an iron bar, without great care, a precipitate of sulphate of iron will also fall with the copper, which can only be properly separated by washing with dilute sulphuric acid; but in doing this great caution is necessary to prevent any loss of copper that might otherwise occur with the iron. In drying the copper the operation must be performed quickly, and the dry precipitate weighed immediately afterwards, otherwise the copper will be subject to oxidation, and, consequently, the result obtained will show a greater per centage than the actual produce of the ore.

The best method of obtaining copper from any of its ores, that Mr. Thomas had found, is that employed in an analysis for separating the copper in solutions of copper and iron, with a current of sulphuretted hydrogen gas. The following process he elucidated with experiments on solutions of copper, which he had prepared for the occasion. The ore, after being reduced to an almost impalpable powder, if not completely decomposed by nitric acid, is to be deflagrated, with three times its weight of nitre, in a red-hot crucible; the alkali is separated by washing with boiling water, and by treating the residue with muriatic acid nothing but the siliceous matter will remain, which must be separated by filtration. The solution is next to be evaporated to dryness and re-dissolved in distilled water, when all the soluble salts will be taken up, and the insoluble parts will remain in the form of a fine gritty powder, which must be separated as before. The solution



should now be of a fine transparent green, or greenish-blue colour, according to the richness of the ore, and it should not contain any excess of acid by which the tests or re-agents would be decomposed, or their action on the copper prevented. A current of sulphuretted hydrogen gas, prepared from the protosulphuret of iron and sulphuric acid, is next passed through the solution, when the copper will be precipitated in black flocks, which is the bisulphuret of copper. To prevent the noxious vapours which invariably arise from the escape of the gas while passing through the solution, the lecturer precipitated the copper by the addition of some pure water saturated with the gas. As this gas has no effect on solutions of iron together with the earths and some other metallic oxides, the copper will be precipitated alone. After the solution has been perfectly saturated with the gas, it is to be filtered, and the residue washed in water impregnated with the gas—the bisulphuret of copper will thus be obtained pure. The filter is next to be dried and burnt, and the residue digested in dilute nitric acid—the solution must be evaporated to dryness and again dissolved in distilled water, and, when filtered, the whole of the sulphur will remain, and the copper once more be in solution; pure potash, or soda, is next to be added, when the copper will be separated in the form of a bulky blue precipitate, which is the hydrated black oxide. When this precipitate is boiled with an excess of potash it becomes black and quickly subsides; but if the quantity of potash be insufficient to decompose the salt completely, the precipitate is green, being a sub-salt of copper. The black precipitate, when dried and ignited, may be calculated at 80 per cent. of pure copper, or may be reduced to the metallic state in a crucible lined with charcoal, after being mixed with carbonate of soda and charcoal dust.

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### Physical Science.

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*Action of Great Fires Preventing the Formation of Storms.* By  
M. MATTENCI.

M. Mattenci had noticed the custom recently established in a parish in Romagna, of kindling great fires with this view, and remarked that during three years that this practice had been followed, the parish, previously ravished every summer by hail, had been spared, while the neighbouring parishes had not been. M. Arago thought that more legitimate conclusions might be drawn from observations made in countries where a great number of high furnaces and smelting houses are met with, as in certain parts of England; but the presence of metallic veins is a complication which necessarily interferes with the results observed. M. Mattenci, on this occasion, pointed out a locality in which the influence of metallic veins does not complicate that of the great fires. In traveling in the Apennines, he found that the cantons in which charcoal and sulphur were manufactured, never suffer by hail.

*Meteorological Journal for 1810, kept at the Lancaster Conservatory of Arts & Sciences, Lancaster, Pa., by WASHINGTON L. ATLEE, M.D., Obs.*

|           | BAROMETER. |        |        | THERMOMETER. |        |        | HYGROMETER. |            |           | SKY.   |        |        | WINDS.   |        |        | CLOUDS. |        |        | RAIN.             |
|-----------|------------|--------|--------|--------------|--------|--------|-------------|------------|-----------|--------|--------|--------|----------|--------|--------|---------|--------|--------|-------------------|
|           | 7 A.M.     | 2 P.M. | 9 P.M. | 7 A.M.       | 2 P.M. | 9 P.M. | Mean.       | Dew point. | Wet bulb. | 7 A.M. | 2 P.M. | 9 P.M. | 7 A.M.   | 2 P.M. | 9 P.M. | 7 A.M.  | 2 P.M. | 9 P.M. | Rain Gauge Inches |
|           |            |        |        |              |        |        |             |            |           | Days   | Days   | Days   | Days     | Days   | Days   | Days    | Days   | Days   |                   |
| JANUARY.  | Average.   | 29.50  | 29.46  | 29.50        | 20.19  | 30.10  | 22.66       | 18.05      |           |        |        |        |          |        |        | 0       | 2      | 0      |                   |
|           | Maximum.   | 29.98  | 29.95  | 29.95        | 43.    | 43.50  | 36.50       | 34.        | 41.25     | 48.50  | 25.75  | 48.50  | Ent. cl. | 6      | 7      | 15      |        |        |                   |
|           | Minimum.   | 28.78  | 28.75  | 29.07        | -1.    | 11.    | 5.          | -1.        | 7.50      | .70    | 0.00   | 10.    | Ent. cl. | 1      | 8      | 14      |        |        |                   |
|           | Range.     | 1.20   | 1.20   | .88          | 44.    | 37.50  | 31.50       | 35.        | 33.75     | 47.80  | 25.75  | 38.    | Prt. cl. | 14     | 16     | 2       |        |        |                   |
| Omitted.  |            |        |        |              |        |        |             |            |           | 1 day  | 1 day  | 1 day  |          |        |        | 0       | 1      | 0      | 2.667             |
| FEBRUARY. | Average.   | 29.62  | 29.58  | 29.59        | 33.57  | 46.57  | 35.28       | 30.86      | 38.68     | 36.15  | 9.17   | 36.67  |          |        |        | 0       | 1      | 2      |                   |
|           | Maximum.   | 29.96  | 29.89  | 29.89        | 55.    | 69.50  | 58.         | 52.50      | 61.       | 58.38  | 20.19  | 62.    | Ent. cl. | 7      | 6      | 10      |        |        |                   |
|           | Minimum.   | 28.94  | 28.87  | 29.08        | -2.    | 18.50  | 6.          | -2.        | 10.25     | 11.24  | 0.00   | 18.    | Ent. cl. | 13     | 10     | 15      |        |        |                   |
|           | Range.     | 1.02   | 1.02   | .81          | 57.    | 51.    | 52.         | 54.50      | 50.75     | 47.14  | 20.19  | 44.    | Prt. cl. | 9      | 13     | 3       |        |        |                   |
| Omitted.  |            |        |        |              |        |        |             |            |           | 2 da's | 2 da's | 2 da's |          |        |        | 1       |        |        |                   |
| MARCH.    | Average.   | 29.31  | 29.27  | 29.34        | 39.33  | 54.61  | 43.07       | 36.29      | 45.54     | 38.01  | 17.90  | 47.67  |          |        |        | 1       | 2      | 0      |                   |
|           | Maximum.   | 29.83  | 29.76  | 29.72        | 59.    | 75.    | 64.50       | 53.        | 61.25     | 60.    | 29.43  | 63.    | Ent. cl. | 5      | 4      | 13      |        |        |                   |
|           | Minimum.   | 28.84  | 28.81  | 28.94        | 20.50  | 32.50  | 24.         | 19.        | 25.75     | 22.73  | 0.00   | 30.    | Ent. cl. | 11     | 5      | 7       |        |        |                   |
|           | Range.     | .99    | .95    | .78          | 38.50  | 42.50  | 40.50       | 34.        | 37.50     | 37.27  | 29.43  | 33.    | Prt. cl. | 13     | 15     | 8       |        |        |                   |
| Omitted.  |            |        |        |              |        |        |             |            |           | 13 d's | 13 d's | 13 d's |          |        |        | 1       | 10     | 14     | 2.759             |

|          | BAROMETER. |        |        | THERMOMETER. |        |        |       | HYGROMETER.   |           |          | SKY.     |        |      | WINDS. |        |        | CLOUDS. |        |        | RAIN.<br>Gauge<br>Inches. |
|----------|------------|--------|--------|--------------|--------|--------|-------|---------------|-----------|----------|----------|--------|------|--------|--------|--------|---------|--------|--------|---------------------------|
|          | 7 A.M.     | 2 P.M. | 9 P.M. | 7 A.M.       | 2 P.M. | 9 P.M. | Mean. | Dew point.    | Wet bulb. | 7 A.M.   | 2 P.M.   | 9 P.M. | Days | 7 A.M. | 2 P.M. | 9 P.M. | 7 A.M.  | 2 P.M. | 9 P.M. |                           |
|          | 7 A.M.     | 2 P.M. | 9 P.M. | 7 A.M.       | 2 P.M. | 9 P.M. | Mean. | Dew point.    | Wet bulb. | 7 A.M.   | 2 P.M.   | 9 P.M. | Days | 7 A.M. | 2 P.M. | 9 P.M. | 7 A.M.  | 2 P.M. | 9 P.M. |                           |
| APRIL.   |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        |         |        |        |                           |
| Average. | 29.61      | 29.58  | 29.57  | 49.98        | 64.57  | 53.57  | 45.37 | 47.48         | 55.54     |          |          |        |      |        |        |        | 1       | 0      | 0      | 0                         |
| Maximum. | 30.        | 29.94  | 29.89  | 71.          | 81.50  | 72.    | 63.   | 75.29         | 76.50     | Ent. clr | 7        | 8      | 17   |        |        |        | 1       | 0      | 0      | 0                         |
| Minimum. | 29.08      | 29.16  | 29.26  | 32.          | 42.50  | 36.    | 29.   | 30.88         | 0.00      | Ent. clr | 5        | 5      | 8    |        |        |        | 3       | 0      | 1      | 1                         |
| Range.   | .92        | .78    | .63    | 39.          | 39.    | 36.    | 34.   | 44.91         | 32.31     | 34.50    | 18       | 15     | 5    |        |        |        | 16      | 5      | 0      | 0                         |
| Omitted. | 2 da's     |        |        |              | 2 da's |        |       | 2 days 3 da's | 3 da's    | Prt. clr | 2        |        |      |        |        |        | 1       | 0      | 0      | 0                         |
|          |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        | 2       | 5      | 11     | 4.855                     |
| MAY.     |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        |         |        |        |                           |
| Average. | 29.45      | 29.44  | 29.45  | 57.81        | 71.45  | 60.58  | 52.52 | 56.34         | 15.11     | 62.37    |          |        |      |        |        |        | 1       | 1      | 2      | 2                         |
| Maximum. | 29.90      | 29.89  | 29.87  | 69.          | 86.    | 72.50  | 65.50 | 70.           | 30.19     | 74.      | Ent. clr | 14     | 4    | 15     |        |        | 2       | 5      | 2      | 2                         |
| Minimum. | 28.74      | 28.78  | 28.98  | 42.          | 45.50  | 40.50  | 38.   | 39.94         | 0.00      | 45.50    | 7        | 7      | 4    |        |        |        | 0       | 0      | 0      | 0                         |
| Range.   | 1.16       | 1.11   | .89    | 27.          | 40.50  | 32.    | 27.50 | 30.06         | 30.19     | 38.50    | 10       | 19     | 12   |        |        |        | 2       | 6      | 8      | 1                         |
| Omitted. | 1 day      |        |        |              | 1 day  |        |       | 1 day         | 1 day     | 1 day    |          | 1      |      |        |        |        | 1       | 5      | 2      | 10                        |
|          |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        | 5       | 3      | 0      | 2.036                     |
| JUNE.    |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        |         |        |        |                           |
| Average. | 29.48      | 29.47  | 29.47  | 66.07        | 78.22  | 67.52  | 60.42 | 62.86         | 15.29     | 64.83    |          |        |      |        |        |        | 1       | 5      | 1      | 1                         |
| Maximum. | 29.80      | 29.81  | 29.77  | 78.          | 89.    | 76.50  | 74.   | 77.99         | 26.49     | 80.      | Ent. clr | 9      | 4    | 10     |        |        | 3       | 6      | 0      | 0                         |
| Minimum. | 29.16      | 29.13  | 29.16  | 54           | 59.    | 53.    | 46.50 | 46.56         | 0.00      | 58.      | Ent. clr | 7      | 4    | 5      |        |        | 2       | 0      | 0      | 0                         |
| Range.   | .64        | .68    | .61    | 24.          | 30.    | 23.50  | 27.50 | 31.43         | 26.49     | 22.      | 14       | 22     | 15   |        |        |        | 7       | 0      | 0      | 0                         |
| Omitted. |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        | 4       | 3      | 2      | 3                         |
|          |            |        |        |              |        |        |       |               |           |          |          |        |      |        |        |        | 5       | 1      | 16     | 3.715                     |



## Meteorological Journal—continued.

|            | BAROMETER. |        |        | THERMOMETER. |        |        |       | HYGROMETER, 2 P.M. |            | SKY.      |        | WINDS. |          | CLOUDS. |        | RAIN.  |
|------------|------------|--------|--------|--------------|--------|--------|-------|--------------------|------------|-----------|--------|--------|----------|---------|--------|--------|
|            | 7 A.M.     | 2 P.M. | 9 P.M. | 7 A.M.       | 2 P.M. | 9 P.M. | ° F.  | Mean.              | Dew point. | Wet bulb. | 7 A.M. | 2 P.M. | 9 P.M.   | 7 A.M.  | 2 P.M. | 9 P.M. |
|            | Days       | Days   | Days   | Days         | Days   | Days   | ° F.  | Days               | Days       | Days      | Days   | Days   | Days     | Days    | Days   | Days   |
| JULY.      | Average.   | 29.37  | 29.56  | 29.56        | 69.63  | 81.90  | 71.13 | 65.79              | 74.05      | 68.08     | 15.91  | 70.74  |          | 1       | 2      | 0      |
|            | Maximum.   | 29.79  | 29.79  | 29.77        | 79.50  | 92.50  | 80.   | 78.                | 83.        | 78.86     | 20.35  | 80.    | Ent. clr | 1       | 4      | 0      |
|            | Minimum.   | 29.20  | 29.27  | 29.24        | 60.    | 70.50  | 60.50 | 54.                | 64.75      | 54.83     | 0.00   | 60.    | Ent. cld | 0       | 0      | 0      |
|            | Range.     | .59    | .52    | .53          | 19.    | 22.    | 19.50 | 24.                | 18.25      | 24.03     | 20.35  | 20.    | Prt. clr | 1       | 3      | 0      |
|            | Omitted.   | 2 da's |        |              | 2 da's |        |       | 2 days             | 2 days     | 2 da's    | 2 da's | 2 da's |          | 1       | 3      | 10     |
| AUGUST.    | Average.   | 29.52  | 29.50  | 29.51        | 69.15  | 79.50  | 70.61 | 65.89              | 73.87      | 66.46     | 11.66  | 71.98  |          | 1       | 0      | 0      |
|            | Maximum.   | 29.87  | 29.87  | 29.85        | 78.    | 89.    | 79.   | 74.50              | 80.625     | 77.48     | 30.50  | 79.50  | Ent. clr | 3       | 3      | 1      |
|            | Minimum.   | 29.24  | 29.19  | 29.15        | 59.5   | 68.    | 51.   | 55.                | 66.75      | 54.50     | 3.     | 64.    | Ent. cld | 0       | 0      | 0      |
|            | Range.     | .63    | .68    | .70          | 18.50  | 21.    | 18.   | 19.50              | 13.875     | 22.98     | 27.50  | 15.50  | Prt. clr | 2       | 3      | 0      |
|            | Omitted.   | 2 da's |        |              | 2 da's |        |       | 2 days             | 2 days     | 2 da's    | 2 da's | 2 da's |          | 2       | 1      | 12     |
| SEPTEMBER. | Average.   | 29.55  | 29.54  | 29.56        | 55.54  | 71.52  | 58.53 | 51.78              | 61.34      | 55.11     | 16.37  | 61.68  |          | 2       | 4      | 0      |
|            | Maximum.   | 29.81  | 29.81  | 29.80        | 68.    | 82.50  | 70.   | 66.                | 71.        | 68.75     | 25.75  | 71.    | Ent. clr | 2       | 6      | 1      |
|            | Minimum.   | 29.16  | 29.06  | 29.13        | 41.5   | 62.    | 46.   | 38.50              | 50.50      | 44.51     | 0.00   | 53.    | Ent. cld | 0       | 0      | 0      |
|            | Range.     | .65    | .75    | .67          | 26.50  | 20.50  | 24.   | 27.50              | 20.50      | 24.24     | 25.75  | 18.    | Prt. clr | 2       | 3      | 0      |
|            | Omitted.   | 2 da's | 3 da's |              | 2 da's | 3 da's |       | 3 days             | 3 da's     | 3 da's    | 3 da's | 3 da's |          | 0       | 0      | 8      |

1.830

[illegible]





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## Architecture.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*A Description of the Eastern Penitentiary, of the State of Pennsylvania, designed and executed by JOHN HAVILAND, Esq., Architect.*

This admirable specimen of prison architecture is situated in the North-western environs of Philadelphia, about two miles from the centre of the city; it occupies an elevated site near the river Schuylkill, and presents one of the noblest, and most commanding architectural objects, in the country. It was commenced in the year 1822, and completed in 1837, at an expense of 600,000 dollars.

The principal front is 670 feet in length, and is wholly composed of finely wrought granite, accurately jointed, and employed in unusually large masses.

The character of the composition is strikingly appropriate to the objects of the building; its bold and massy features, its broad lights and deep shadows, its well proportioned and well managed openings, and the expressive unity of design which characterizes the whole, produce on the mind of the spectator a most solemn and impressive effect.

The entire façade is *castellated*, and its embellishments are in the "early pointed," or "lancet" style of English Gothic. The gate of entrance, which occupies the centre of the front, is fifteen feet wide by twenty-seven feet high; the upper portion of it is secured with a massive wrought iron port-cullis, and the lower part with immense oaken gates, studded with projecting iron rivets; the jambs of the opening are strengthened by massy buttresses, which, at the same time, impart a bold architectural effect to the composition.

On either side of the entrance a square tower is constructed, of fifty feet in height, crowned with an embattled parapet, supported by pointed arches springing from corbels. These towers define the extent of the centre building, which is about 200 feet, and their projection from the face of the main wall is ten feet. The curtain between the towers is also embattled, and its height from the ground is forty-one feet.

The extremities of the front are finished with octagonal towers pierced with loop-holes and pointed windows, and crowned with embattled parapets; and a massy octagonal tower rises out of the centre of the front to the height of eighty feet, thus forming a picturesque termination to the group.

The outside walls are thirty feet in height, twelve feet thick at the

base, and 640 feet in length on each side, thus enclosing a space equal to about *ten* acres.

The cells are built in *seven* blocks or ranges, radiating from seven sides of an octagonal building of forty feet in diameter, situated in the centre of the enclosure. The cells of each block are built on either side of a spacious corridor, and these corridors all lead to the centre building, thus affording a view of every cell door in the whole establishment from one and the same point of sight. The upper part of the centre building constitutes an observatory, from which a complete supervision may be had over the entire enclosure; and the lower part, or cellar, contains a reservoir for supplying the establishment with water.

The whole number of separate cells contained in the *seven* ranges, amounts to 844. The three blocks which were first erected are but one story in height, and to each cell is attached a separate yard of eighteen feet long by eight feet wide, surrounded by a wall of twelve feet in height; these enclosures were intended as airing yards for the prisoners, but it has been found, by experience, that the ample dimensions of the cells, and their perfect ventilation, render it unnecessary to remove the prisoners *at any time* from their cells, except in case of sickness; hence, in the four ranges which were subsequently erected, the yards have been omitted, and the cells made two stories in height. The second stories are approached by means of galleries extending along the corridors, supported by cast iron brackets; the stairs, and the ballustrading on the galleries are also composed of cast iron.

The cells of the different blocks, or ranges, differ in dimensions, the smallest being eleven feet nine inches long by seven feet six inches wide, and the largest, fourteen feet nine inches long by nine feet wide. Each cell has a separate hydrant, a water closet, an aperture for admitting pure air, and a flue for ventilation.

The whole prison is warmed on Perkin's plan of hot water circulation through iron pipes, and those who have the management of the institution seem to be satisfied that the plan is a good one for such an establishment.

The front building, through which the prison is entered, contains, on the right of the gate-way, commodious apartments for the Warden, and chambers for the meetings of the Inspectors. On the left, are the clerks' offices, and the rooms of the deputy keepers. Over the entrance, on the second floor, are the apothecary's apartments, and in the left wing, the infirmary.

A high degree of architectural taste and skill is evinced in the whole design of this noble and costly structure, while the beauty and



solidity of its execution are equally creditable to its accomplished and tasteful architect, John Haviland, Esq., whose name it is destined to transmit with honour and renown to after ages.

T. U. W.

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## **Mechanics' Register.**

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LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1840.

*With Remarks and Exemplifications by the Editor.*

1. For an *Electro Magnetic Telegraph*; Charles Wheatstone and William Fothergill Cooke, of Great Britain, June 8. Patent for 14 years from the 12th of June, 1837, that being the date of the English patent.

It would be fruitless to attempt even a sketch of this apparatus as the specification covers 52 pages of folio with numerous references to complex drawings. The claims which cover more than four pages of folio need not be given, as they could not be understood without the drawings to which they refer. The instrument is used for giving signals and sounding alarms in distant places by means of electric currents transmitted through metallic circuits. The specification is published at large in some of the English Journals.

2. For improvements in the *Machine for Cutting Corks*; Samuel Sawyer, Boston, Massachusetts, June 10.

The corks are cut by a revolving circular knife, which is sharpened, during the operation of the machine, by a revolving whetstone. The cork is gripped between two revolving borders working in a vibrating frame by which it is moved towards and from the revolving knife. The taper is given to the cork by having the axis of one of the holders below that of the other. Two or more frames with holders, &c., can be placed around the knife, which revolves horizontally, the axis of the vibrating frame or frames being immediately under its edge. A clear idea of the arrangement of the machinery which gives motion to the vibrating frames and holders, &c., could not be given within the limits of a brief notice.

The claims are, 1st, to the method of rounding or forming the cork by means of the revolving circular knife in combination with a movable or vibrating frame operating in the manner described in the specification. 2nd, to the sharpening of the revolving knife while in operation, by means of a revolving whetstone. 3rd, to the causing of both holders to revolve by means of the system of bands and pulleys described, thereby preventing the liability to twist the cork, while in the process of formation. The 4th claim is to a peculiar arrangement of the apparatus for withdrawing one of the holders to discharge the cork which has been cut, and to receive another. The 5th is to certain matters of minute detail, explained by reference to the drawings.

3. For an improvement in the manner of constructing a *Cooking Stove*; William Gallup, Norwalk, Huron county, Ohio, June 10. (See specification.)

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4. For an *Ever-pointed Pencil Case*; Thomas Woodward, Brooklyn, New York, June 10.

The pencil holder slides within the lining of the pencil case, and has a pin projecting from its upper end which slides in a straight slot in the said lining, and the pencil is prevented from being forced in when writing by means of a notch at the lower end of the straight slot into which the before mentioned pin is forced. The pencil-holder and pencil are worked in and out by a section of the outside casing which revolves upon the lining, it being provided with a spiral channel or slot inside, into which the end of the pin that passes through the straight slot fits. This last mentioned revolving tube is prevented from sliding up and down by the upper and lower portions of the tube which are permanent. By turning the revolving tube with the spiral groove, or slot, the pin on the holder is made to slide in and out, and when at the bottom of the straight slot it is forced into the notch at the end thereof, and is thereby prevented from being forced in until it has been turned and relieved from said notch.

The claim is to the "forming of the spiral channel for protruding and retracting the pencil-holder within the sectional tube, and combining this tube with the other parts of the case under the particular arrangement set forth so that the upper and lower portions shall remain stationary whilst it is made to revolve. And also the manner of locking the point by the combined operation of the straight and spiral slots as set forth."

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5. For an improvement in the *Spring Bolt of Doors and other Locks*; Geo. W. and Ezra B. Robinson, Boston, Massachusetts, June 10.

The following is an extract from the specification, together with the claim: "Our said improvement consists in inserting a bar of steel or other metal which may be about a quarter of an inch square for an inside door lock, and about seven-eighths of an inch long, (and longer or shorter for other locks in proportion,) into a longitudinal slit in the projecting end of the spring bolt, the bar to project just as far from the box of the lock as the bolt does, and to enter into the box at the other end just far enough to turn upon a pivot passing through the bar and through the bolt. The inner end of this bar is rounded off on the side which sets against the lock plate, and on the opposite side, and between the pivot and the inner end of the bar is a transverse groove into which the end of a flat spiral spring plays, to bear the rounded corner down against the lock plate, and so elevate the opposite end of the bar which projects from the box at an angle of about forty-five degrees with the bolt; the other end of the flat spring is fastened to the bolt nearer to the end, which is connected with the knob

by which the bolt is drawn back. The bar being thus elevated by the pressure of the spring upon the inner end of it, when the door shuts, the end of the bar first comes in contact with the catch, and as the door closes the bar is pressed into the box, turning at the same time on the pivot and carrying the bolt in with it without any friction against the catch, and the door is shut very easily and quietly." "What we claim as our invention, and desire to secure by letters patent, is the bar of metal turning on a pivot in the spring bolt, and provided with a spring in combination with the spring bolt for the purpose and in the manner described."

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6. For improvements in the *Baker for Culinary Purposes*; Gardiner Chilson, Boston, Massachusetts, June 10.

This is a modification of that kind of baker in which the double reflector is used in combination with, and united to, a cylindrical or elliptical furnace; it consists of an elongated chamber, placed above the radiating chamber and furnace, and divided into three compartments provided with boiler holes at the top, and separated from each other by two partitions. There are valves, or dampers, to regulate and conduct the draught through either, or all, of these compartments, and then out at the pipe. The claim is to the elongated hot air chamber (divided into apartments) with the elliptical or cylindrical furnace, "and also the combination of the latter with the double reflecting baker surrounding the same, the whole being constructed and arranged substantially in the manner above set forth, for the purpose of retaining and circulating the heat throughout the apparatus, and causing it to accomplish the several operations above mentioned in a very effectual manner and with great economy of fuel."

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7. For an improvement on the *Rotary Steam Engine*; James Moore, Elizabethtown, New Jersey, June 10.

This patent was obtained for what the patentee calls "an improvement on the Rotary Steam Engine, patented by John Drummond, on the 3rd of August 1839, and noticed in this Journal, Vol. xxvi. p. 158.

The channel for the piston is formed by the union of two disks, each having half the chamber, and from the shaft to within a short distance of the said channel, each disk is hollowed out to make a chamber. The piston is connected with the shaft by a thin plate of metal which passes between the two disks, or rather between the two ridges made by the chamber near the shaft and the channel for the piston, hence there must necessarily be a space left between these two ridges for the escape of steam. Mr. Drummond, in his engine, has endeavoured to prevent this by the elasticity of the packing; but it must be evident that the plate, which forms the connexion between the shaft and piston, in running round will prevent the packing from closing so as to exclude the steam. In the present patent this is attempted by means of a spring ring, the inner edge of which is attached to the lower disk, the outer edge resting upon the upper disk. A friction roller attached to an arm on the shaft travels in front of the



connecting plates and forces down the spring to allow it to pass, the elasticity of the ring closing it up after the plate has passed. The patentee says, "what I claim as my invention, &c., consists in the arrangement of the circular spring plate inside the cylinder for closing the joint between the plates forming said cylinder, to prevent the escape of steam, in combination with the roller for contracting said spring plate, in order to allow the arm to pass round."

We rarely meet with a new patent for a Rotary Steam Engine, without regretting the little information that is possessed by those whose aim it is to show their knowledge upon the subject, by professing to have improved this instrument. We have taken repeated opportunities of making known our own conviction that the production of a rotary engine which shall be equally efficient and economical with the reciprocating, is scarcely within the bounds of possibility. Not merely because the parts of a rotary engine, under most of its forms, are more subject to friction and wear than the reciprocating, but from causes which are inherent, and which, therefore, the highest talent and skill cannot surmount. There was a time, it is true, when this conviction did not exist, and the thing was attempted by a Watt, and by others distinguished for their knowledge in the matter; but few, however, of the two hundred patents which have been obtained in England and in this country were then in being, but they now exist, or rather have existed, as sunken rocks, which serve, in general, to deter all those who know how to consult the chart from venturing on a navigation where there is little else than shoals.

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8. For an improvement in the *Horse Power*; Enoch Piper, Camden, Waldo county, Maine, June 10.

This patent is taken, for an improvement on the endless chain horse power, and the improvement consists in a peculiar mode of sustaining the endless floor on which the horse treads. The claim appended to the specification will give a sufficiently clear idea of the principle. "Now what I claim as my invention and improvement is the mode of arranging and sustaining the floor planks by attaching the middle of each of the belts midway between the axles of the trucks, and bringing their ends to bear on the axles, yet with liberty to rise from the axles in passing around the drums as set forth in the foregoing description, and in any similar manner embracing analogous arrangements or principles of action."

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9. For a mode of *Applying the waste heat of Blast Furnaces to Steam Boilers*; Martin Bell, Antis Township, Huntingdon county, Pennsylvania, June 10.

As the waste heat of furnaces has long since been applied to generate steam in boilers, the claim in this patent has been limited to the peculiar arrangement of the flues and the boilers, so that the flame, smoke, &c., may either be carried through the flues of the boilers, or directly out of the chimney of the furnace, and as this arrangement could not be made very clear without drawings, we merely add the

claim, which is in the following words, viz: "Having thus fully described the manner in which I construct my flues and boilers for the purpose of employing the waste heat of a blast furnace for the generating of steam, to be applied to the working of a blowing apparatus, by which the furnace itself may and can be blown, and the necessary blast furnished therefor, and for other purposes; what I claim therein as constituting my invention and discovery, and which I desire to secure by letters patent, is the arrangement of flues and other necessary appendages as herein before described, by which I connect a pair or pairs of boilers with a blast furnace, substantially in the manner set forth and described, thereby applying the flame and heat escaping out of the top of the furnace, to create a steam power, which may be used to blow the furnace, and which may also be applied to other purposes."

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10. For a mode of *Sustaining Metal Roofs*; Peter Naylor, New York city, June 12.

The plates of metal constituting the roof are united together by riveting, and are bent so as to form a series of arches. Iron truss frames extend across, and above, these plates from wall to wall, upon which they rest as abutments. The metal roofing is suspended to these truss frames by screw bolts. The metal roofing may be formed in various ways, the particular construction of this part not being claimed as constituting any part of the invention. The claim is in the following words, viz: "Having thus fully explained the nature of my invention, and shown the manner in which I carry the same into operation; what I claim as constituting my improvement, and desire to secure by letters patent, is the combining of iron truss beams, constructed in the manner herein described, with the plates constituting the metallic roofing, the said truss beams being placed above the roofing, and sustaining the same upon the suspension principle, substantially as herein described."

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11. For an improved *Hill Side Plough*; Daniel Gochnour, Jr., Cone-maugh Township, Cambria county, Pennsylvania, June 12.

A mouldboard with two shares, each alternately answering the purpose of a coulter, is connected with the land-side, which is the same on either side, by means of two pivots, one on the forward end of the land-side, fitting into a hole in the share, and the other on the end of a brace attached to the back part of the mouldboard, fitting into a hole in the heel of the land-side, so that the mouldboard can be shifted by turning under the land-side. The mouldboard is fastened by a bolt that passes through a mortise in the beam, and turning on a pin therein, the lower end of which catches on to that share which acts as the coulter, and the upper end jointed to a connecting catch rod worked by the ploughman. The claim is in the following words, viz: "What I claim as my invention and constituting my improvements on the Teeter Plough, is the manner in which I have combined the mouldboard with the land-side by making the mouldboard turn on the point of the land-side, instead of on a roller placed

in the bar of the land-side at a distance from the point as in the Teeter plough, by means of which arrangement I am enabled to use the shares of the Teeter plough alternately as a coulter and share, thereby dispensing with the ordinary fixed coulter employed in said Teeter plough. I also claim in combination therewith, the method of securing the mouldboard to the alternate sides of the land-side by means of the catch and rod as described."

12. For an improved mode of constructing the *Mouth-pieces for Mail Bags, Traveling Bags, &c.*; James Sellers and Abraham L. Pennock, Philadelphia, Pennsylvania, June 12.

We will quote the following from the specification, viz: "Our mode of making such mouth-pieces, we modify in various ways, but in each of them the mouth-piece consists of three or more pieces or sides, so arranged that two or more of them, which must be inflexible, connected by a single fastening, confine the remainder. If formed of three pieces or sides, two of them are of wood, metal, or other inflexible material, hinged or jointed together by a flexible connexion, and one of them of a flexible material. If formed of four or more pieces or sides, all of them are made of an inflexible material, hinged or jointed together by a flexible connexion, or at least so many of them as are requisite to confine effectually the mouth of the bag when closed. When flexible pieces are employed, they are to be contained, when the mouth is closed, between other pieces which are inflexible. When our mouth-pieces form a figure not exceeding four sides, two opposite sides are to be united for the purpose of fastening the whole. In figures of six sides, when all are external, the two middle pieces are to be united; in figures where all the sides except two, are included between, or held confined by, two external or controlling pieces, these controlling pieces are to be united; and in radiating figures, the pieces composing alternate sets are also to be united. In each case this union is to be effected by some means appropriate to the purpose, and by which a catch, lock, or other device for securing the mouth may be attached. Such means may consist of plates projecting from those pieces, in a line coinciding with the face line of such pieces, and a hasp to confine them, the hasp being secured at one end by a hinge, and at the other, held down by the shackle of a padlock, or other catch, passing over such hasps, and through one or more of the projecting plates; or when the connexion is effected by the union of two pieces only, the ligament, when other convenience does not forbid, may be a staple fastened to one piece, and passing sufficiently through the other to admit of attaching the required catch, or lock. What we claim as our invention, is the making of such mouth-pieces so that they shall consist of three or more sides, and be so formed and arranged upon the principle, and in the manner herein shown, that two or more of the sides which must be inflexible, shall confine the remainder by a single fastening, the flexible portions when used being embraced and confined between other portions which are inflexible, in the manner herein shown."



13. For *Ponton Equipages for the use of Armies*; E. M. Huntington, Administrator of John F. Lane, Terre Haute, Louisiana, June 17. (See specification.)

14. For improvements in the *Machine for pressing Hats, Bonnets, and other articles*; Richard Murdock, Baltimore, Maryland, June 17.

This patent was granted for improvements on a machine long since used for pressing hats, &c., in which the hat to be pressed is placed on a block attached to a revolving shaft, and the irons applied to the various parts of the hat by a lever.

The improvements claimed are for various modifications of the machinery, and it would be difficult to give a clear description of them without drawings, to which the claims refer.

15. For an improved *Bathing Apparatus*; George S. Byrd and Peter Milne, New York City, June 17.

The bathing tub is to be placed in the story next above the kitchen, and six or seven feet above this tub is placed a reservoir of cold water, at the bottom of which there are two valves opening upwards, and to be operated by the necessary connexions placed within the reach of the person bathing. From one of these valves a pipe descends to the boiler in the kitchen, in which boiler the pipe is coiled, and thence ascends to a "compound standing pipe" leading to an aperture in the bottom of the bathing tub, so that the water which descends in the tube becomes heated, and rises to supply the hot water. Another pipe descends from the second valve in the bottom of the reservoir also to the "compound standing pipe," to supply the cold water, both passing into the bathing tub through the same aperture. The "compound standing pipe" is provided with a valve, opened by a connexion within the reach of the person bathing, to discharge the water in the bathing tub. It is also provided with an overflow pipe, which branches off from the "compound standing pipe" upon a level with the line to which it is desired that the water shall rise in the tub. By the above arrangement it will be seen that the hot and cold water are supplied through the same hole in the bottom of the bathing tub through which the water is discharged. The patentees say, "what we claim as our invention, and desire to secure by letters patent, is the compound standing pipe, as described, together with the mode of supplying hot and cold water to bathing tubs, by means of the compound standing pipe, &c., and the combination with the same of the overflow pipe, the whole being constructed in the manner, and for the purpose described."

16. For improvements in the *Stove and Kettle for making Varnish, Cooking, &c.*; Harman Hibbard, Utica, Genessee county, New York, June 17.

We are told by the patentee that the "nature of his invention con-

sists in constructing an apparatus styled "the economic stove," with appendages to perfect its utility. We are also informed that he "produces, and regulates, and applies the same to a variety of purposes, such as culinary uses, and making varnish," &c., and after specifying many advantages and various purposes to which it may be beneficially applied, he concludes by limiting his claim to the "constructing of stoves for making varnish, or other purposes, with a movable furnace, moved, raised, or lowered, by hand, lever, crank, spring, or other similar arrangement, so as to regulate the distance of the fire from the kettle, or other utensil, to which the heat is to be applied; likewise the application of the stirring tube and concave lid to, or its combination with, the varnish kettle, as set forth." We apprehend that the great number of objects to which he intends to apply this invention will scarcely enable him to sustain the first section of his claim, should he have occasion to prosecute any one for the infringement of his patent, as stoves have long since been made with a movable furnace; and no special combination or arrangement of parts is pointed out, to enable us to tell upon what foundation the claim rests.

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17. For a mode of *Setting the Bricks in a Brick Kiln*; Henry Read, Kensington, Philadelphia county, Pennsylvania, June 17.

In arranging the bricks, as stated in the specification, arches are made in the usual manner, except that they are less in number, and flues are made running from arch to arch, between every two bricks, and extending from the bottom of the arch about two and half inches in width to within one brick from the top, and then covered over. The claim is in the following words, viz: "What I claim as my invention is the above manner of setting the bricks in a kiln, for the purpose of burning; that is to say, I claim the leaving of flues for the free passage of the flame and draught between every two or three lengths of bricks; said flues extending from arch to arch, throughout the whole length of the kiln, and being arranged and constructed substantially, in the manner herein set forth."

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18. For a mode of *Warming Buildings*; John A. Stewart, of Philadelphia county, Pennsylvania, June 17.

The walls of houses are to be made double, and the spaces between the two walls are to constitute flues, so that the draught from the fires will pass through these spaces.

The patentee concludes by saying, "I am aware that double walls, resembling those described by me, have been heretofore constructed for the purpose of protecting the interior walls from the effects of moisture, and also with a view to obviate, in some degree, the effect of change of temperature, a stratum of air being thereby interposed between the outer and inner portions; I do not, therefore, make any claim to a structure of this kind so far as it is adapted and applied to the purpose above mentioned. But what I do claim as constituting my invention, and which I desire to secure by letters patent, is the formation of the spaces between such double walls into flues, in such

a manner as that the draught from fire-places or stoves of any kind may be made to pass between said walls, in the manner described, whereby they will be kept perfectly dry, and a large portion of the heat usually lost, will be conducted and radiated into the rooms; the whole being constructed, and operating substantially, as herein described."

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19. For an improvement in *Axletrees and Boxes of Carriages*; Lyman Smith, Jr., and Griffin R. Waring, Derby, New Haven county, Connecticut, June 17.

This patent is for a mode of connecting the hub to the axletree without a linch-pin; and for this purpose the inner end of the box of the hub is provided with a flanch, and the axletree with a cap which passes over the flanch on the box or hub; set screws, or a key, pass through the cap and in front of the flanch on the box, so that the hub and box can be taken from the axletree without removing the set screws or key. The claim is to the "method of securing the box or wheel in its place on the axle by means of the flanch on the box, the cap on the axle, and the set screws on the key, in the manner described, instead of using the linch or nut on the end of the axle."

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20. For improvements on the *Truss for the Cure of Hernia*; William B. Dodson, city of Louisville, Kentucky, June 17.

As the specification of this patent is of great length, and the claim refers to the drawings, which are numerous, and could not be understood without them, we will not attempt any description of the invention.

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21. For an improvement in the *Whippletree for Carriages*; James Jorey, Stafford, Tolland county, Connecticut, June 17. Assigned to B. Fowler, Jr.

The patentee says, "The nature of my invention consists in applying a yoke to the centre of the whipple-tree to prevent its becoming disengaged in that point, and two studs called side guards attached to the cross bar of the thills of carriages, to prevent too great vibration of the whipple-tree." "What I claim as my invention, and desire to secure by letters patent, is the employment of the yoke in combination with the whipple-tree and central pin, as described, and also the wing guards in combination with the whipple-tree, for the purpose and in the manner described."

The yoke is a strap of iron which passes around the thills and the middle of the whipple-tree, where it is jointed to the thills, so that should the pin by which the two are jointed give way, the whipple-tree will be retained by the yoke. The wing guards are two iron studs attached to the cross bar in front of the whipple-tree, and near each end of it, so set that they allow sufficient play to the whipple-tree, and should one of the traces break, will prevent it from swinging too far.



22. For an improvement in the *Straw Cutter*; Joseph Worley, Hawkins county, Tennessee, June 20.

This straw cutter has the feeding box standing vertically, and the knife cutting by a horizontal sliding motion. An arm extends from each of two vibrating beams, and the knife is jointed to these arms. One of said arms extends out beyond the point at which the knife is jointed to it, and is connected with a crank pin on a fly wheel by a connecting rod, so that as the crank revolves the beams vibrate, and thus give to the knife an oblique, or draw, cut. The press block which holds the straw whilst the knife is cutting, is pressed up by a spring, and thrown back to allow the straw to descend, by a cam on the fly wheel, which works against the end of a connecting rod jointed to a lever, one end of which forces back the spring which bears against the press block. The claim is as follows, "What I claim as my invention is my plan of giving to the knife an oblique or draw cut, by means of the vibrating beams to which the knife is attached, as above described. Also the means by which the press piece is made to operate, consisting of the combination of the spring, the lever, and the connecting rod, acted upon by the cam on the fly wheel, as described. Also the particular manner in which I have combined said press piece, hopper, and knife, as herein set forth."

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23. For an *Argand Burner for Burning Spirits of Turpentine*; Charles Carr, Philadelphia, Pennsylvania, June 20.

This patent is obtained for adapting the burner of oil lamps to the burning of spirits of turpentine. The inside tube of the turpentine burner is extended some distance above the top of what is the burner when made for oil, and is armed with points inclining upwards. To the outer tube is adapted a sliding tube, which at its upper end is of a conical form, and approaches at its mouth so near to the inner tube as just to allow space for the free passage of the strip of cotton cloth forming the wick; this is armed within with points similar to those on the inside tube, and by means of these two sets of points the wick may be raised. As the outer tube is slid up the points catch the wick and carry it up, and when drawn down, the points on the inner tube catch it and prevent it from sliding down. The patentee claims the "manner in which he has connected and combined the sliding tube with the ordinary Argand's oil burner, so as to adapt it to the burning of the spirits of turpentine, and to the raising of the wick, as set forth."

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24. For a *Mowing Machine*; Seth Lamb, New York City, June 20.

Sickles are attached to the rim of a horizontal wheel in the front of the machine—they are curved in the usual way, are provided with teeth, and are so placed as to incline in the direction of the motion of the wheel. As the wheel revolves, the sickles pass between guides, or fingers, placed below, and extending out in front and beyond the end of the sickles, and bows, or guards, which reach from the points of the guides, or fingers, being attached to them, to some distance

back of the point where the sickles are affixed to the rim of the wheel. On each side of the front of the machine there is a guide inclining out, so that the grain, as it is cut, is gathered in, and made to pass over the sickle wheel within that part of its diameter where the gearing to drive it is placed. The guides, or fingers, may be made with a sharp edge, or with teeth like the sickle. The grain is deposited on a platform at the back of the sickle wheel, and on a level with its top; and by the side of this platform there is another, somewhat elevated, on which the grain is placed when removed from the first, and there made into sheaves, whilst the machine is in motion.

The claim is to the combination of the bows, or guards, with the guides, or fingers, the sickles and the guards at the sides of the front of the machine. Also the platform on which the grain is placed to be made into sheaves—and, finally, the “placing of the sickle wheel and its appendages at the inner side of the machine, so as to permit the horse to travel by the side of the grain in front of the machine, and to allow the platform (on which the sheaves are made,) to extend by the side of it, for carrying the grain.”

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25. For a *Cooking Stove*; Charles Guild, Cincinnati, Ohio, June 20.

This patent has been granted for a peculiar arrangement of the flues and dampers, which could not be clearly described without reference to drawings. The oven is placed below the fire chamber, the bottom of the latter being the top of the former. The fire chamber and the oven are both divided into two compartments by a movable partition. The space around the oven is divided into four flues by three partitions, and the arrangement of these, with the dampers, for the purpose of giving a proper direction to the draught as the entire, or only half, of the fire chamber, and one, or both, the ovens are used, forms the subjects of the claim, which need not be given, as it refers to the drawings, and could not be clearly understood without them.

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26. For an *Electro-Magnetic Telegraph*; Samuel F. B. Morse, New York City, June 20.

This patent was granted for an arrangement of signals and types, adapted to a dictionary or vocabulary of words, and for an arrangement of machinery for transmitting signals by means of electro-magnetism, or galvanism. The specification is long, the drawings complex, and the subject one which could not be understood without a full description thereof, and we will not undertake to give a mere sketch of it. The subject could not be justly treated in this way, and it is the less necessary, as the nature and merits of the invention have been spoken of in several of our journals. The subject had been pursued by Professor Morse for a number of years, before he obtained his patent; and in the arrangement of the parts of his machinery there is a manifestation of much skill, in adapting the means to the attainment of the proposed end.

27. For a *Churn for making Butter*; Allen and William A. Crowell, Salisbury, Litchfield county, Connecticut, June 20.

The patentees say that the nature of their invention consists "in the formation of a chamber, or space, in the lower part, or the bottom of the churn, or adjoining any part thereof, for containing hot or cold water, or other liquids, for the purpose of tempering the milk or cream in the churn to the proper degree of heat required for churning, so that it can be done easily, and rapidly, to the will." They have described their improvement as applied to that kind of churn in which the cream is put into a vessel, the bottom of which is semi-cylindrical, and made of metal, and the dashers attached to arms projecting from a horizontal shaft. The chamber for hot, or for cold water, is outside of the metallic semi-cylindrical bottom. The claim is confined to this device for keeping the cream to the proper temperature; in which, however, there is no novelty.

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28. For an improvement in the *Mortising Machine*; Andrew Bailey, Jefferson, Ashtabula county, Ohio, June 20.

This is alleged to be an improvement on that kind of mortising machine in which the chisel is attached to the lower end of a sliding rod, so that it can be swiveled around to cut to the right or left, the upper end of the rod being jointed to a lever, worked by a treadle. The improvement consists of a peculiar mode of making the swivel chisel socket, which has a stem passing into a hole in the chisel rod, and is retained there by a segment of a ring collar which passes on to a groove made in the stem of the chisel socket, there being a lateral mortise through the lower part of the chisel stock to admit of its being put on; the collar rests upon the lower part of the mortise and connects the chisel socket and stock, admitting of a free rotary play to the former. When it is desired to prevent them from turning, the two are connected together by a right angled piece, one link of which passes into a hole made in the chisel socket, running down from the shoulder which bears against the bottom of the chisel stock, and the other passes out through a lateral square aperture made one-half in each piece. That link of the right angled catch which runs down the chisel socket has a spiral spring wrapped around it, and bearing it up, so that the socket cannot turn, but when it is forced over so as to clear that part of the aperture which is in the chisel stock, it turns freely. By having two such apertures, the chisel socket can be turned to each of them and held in place. The claim is confined to the combination of the swivel chisel stock, chisel socket, and spring catch, constructed and operating as described.

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29. For a *Cheese Press*; J. A. Fletcher, Irasburg, Orleans county, Vermont, June 20.

The follower of this press slides in the two opposite and vertical sides of a frame, and above the follower, a lever is jointed to each of these side pieces, the shorter end bearing upon the follower, and the longer end being attached to a cord by which the whole press is sus-



pended, so that the pressing is effected by the weight of the press as well as by that of the cheeses to be pressed, and in this particular it differs from all other cheese presses which we have seen. The patentee says, "what I claim as constituting my invention, and desire to secure by letters patent, is the so forming and combining the respective parts, as herein described, that the whole press, with its load, shall be suspended by the longer arms of the lever, and the shorter arms be thereby caused to act upon the follower as set forth."

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30. For a *Cooking Stove*; Horace Strickland, Bradford, Orange county, Vermont, June 27.

In this stove, the oven is placed behind the fire chamber, there being two plates between them with an open space for the free circulation of the air of the room. The space over the top of the oven is divided into three by two partitions running from front to back. The exit pipe is placed over the back end of the middle division of the top. The valves are so arranged that the draught may be carried along the side divisions over the top, down the back, along the bottom, up the front, and along the middle division to the exit pipe; or else down the front, under the bottom, and up the back to the exit pipe, a portion of the draught at the same time passing over the top to the exit pipe also. Two small furnaces with boiler holes are placed at the back end of the top, one on each side, with a pipe leading from each to the exit pipe.

The claim is in the following words: "What I claim as my invention, and desire to secure by letters patent, in the above described stove, is the particular manner in which I have arranged the flues around the oven by dividing the upper flue into three parts, and governing the passage of the draft through the middle section by means of the two dampers, operating as herein set forth. I also claim the manner in which I have combined and connected the small furnaces with the stove and its flue for the purpose described." "I do not claim the mere carrying of the flue around the oven, nor the dividing the upper flue into three sections, this having been before done, nor do I claim the employment of valves or dampers generally, but I limit my claim in these particulars to the special arrangement made by me of the said dampers and flues as herein set forth."

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31. For a *Portable Saw-Mill*; Samuel Hamilton, New York City, June 27.

The frame, on which the log is secured to a permanent head stock, is nearly upon a level with the ground line, and the frame on which the machinery moves that works the saw, is erected above, so that the saw projects below this framing and through the log, and the frame and machinery to which it is attached and by which it is worked, slide on ways in the manner of the carriage of a common saw mill. The saw therefore moves up to the log instead of the log moving up to it. The patentee says, "I do not claim as my invention any of the above parts of the said machine, taken separately and without their connection

in said machine, or application to the purpose aforesaid." "But I do claim as my invention and improvement, the mode above substantially described, of mounting the working machinery and moving the same above the log or timber to be sawed in the manner aforesaid, or in any other manner substantially the same, so that the saw works through the log by its own travel, while the log is secured on stationary head stocks nearly on a level with the ground line."

32. For a *Locomotive Steam Engine*; Asa Whitney, Rotterdam, Schenectady county, New York, June 27.

The engine is secured to a frame which rests on two four-wheeled carriages, there being trucks under the frame which rest on the top frame of each carriage. The wheels of each carriage are connected together by means of a crank on each end of the axles, and a connecting rod on each side, so that each carriage has four driving wheels, and the four wheels of each carriage are connected together so as to make a locomotive with eight driving wheels. This last connexion is effected by having a cog wheel on the hind axle of the front, and another on the fore axle of the back carriage, which wheels mesh into a cog wheel on the crank shaft situated between the two. The cog wheels being in the middle of the axles, the slight vibration occasioned by passing around a curve will not materially affect the working of the cog wheels.

Claim.—"I do not claim any one of the parts of said engine, or locomotive, separately and independently of the arrangements and combinations herein set forth and claimed, nor any combination or combinations of the parts aforesaid, not herein specially named and claimed as my invention and improvement, but I do claim, in the first place, as my invention and improvement, the combination of the cog or spur wheel with the two pairs of driving wheels nearest to them, in combination with the rod connecting the front and rear wheels with the middle wheels, by which combination of the cog wheels and connecting rods with the driving wheels, the power of the engine is communicated to the whole number of the driving wheels, when the engine is put in motion." "I also claim the above method of connecting the wheels of the locomotive, so as to constitute four pair of driving wheels in combination with the frame extending over both carriages, resting on bearings, and supporting the weight of the engine on two separate carriages as herein set forth, thereby securing the adhesion to the rails of the whole eight wheels."

33. For an improvement in the manner of *Constructing the Dies for Manufacturing Knobs for Locks, Drawers, Bell Pulls, and for other purposes*; Lucian E. Hicks, Middletown, Connecticut, June 27.

The above named patent is taken for an improved mode of making dies for manufacturing knobs, so that each knob shall be made of one single piece of plated metal. The knobs are to be formed, as usual, by means of two polished steel dies; but the lower die, instead of ending where the form of half the knob terminates, is continued up to

some height, cylindrically, and the outside of the upper die is also cylindrical, and fits into the cylindrical part of the under die. The hollow or cavity of the upper die, which forms one half of the knob, meets its cylindrical part at a perfect edge; after the metal has been raised so as to form one half of a knob, the part which is to constitute the other half being cylindrical, the piece thus prepared is placed within the lower die, into which it should fit exactly; then when the upper die is brought down upon it, the cylindrical portion of the plated metal will be thereby made to assume the desired form, and the knob be completed.

There are certain appendages to the lower die, which are referred to in the claim, but which we do not think it necessary particularly to explain; the main feature of the invention being that above set forth. The claim is to the forming of the cup of the lower die with cylindrical sides, and adapting the upper die thereto by forming its outside cylindrical, and of such size as to fit the lower dies, whilst the junction of its cylindrical sides, and its hollow or cup, constitutes a sharp edge in the manner and for the purpose described; and also the combining with the lower die, the bolt with its shoulder for the purpose of forming the hole in the knob and of raising it from the die.

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34. For improvements in the *Machine for Cleaning Feathers*; John H. Stevens, of the City of New York, Assignee of Robert B. Lewis, June 27.

The feathers are put into a perforated cylinder, the axis of which turns on a sliding frame, which frame slides in grooves made in the two opposite sides of an outer stationary cylinder. In the space left between the stationary cylinder and the inner perforated cylinder, pipes are arranged through which steam is to be conveyed. A pipe governed by a cock admits the steam to these pipes, or cuts it off at pleasure; at the bottom of the machine there is also a pipe for the discharge of the condensed water. The inner cylinder is provided with suitable doors to admit and remove the feathers. The claim is to the combination of the horizontal and circular pipes with the outer cylinder, together with the means of letting in and shutting off the steam. There are other claims made to the particular manner of arranging certain parts, not easily described, and, as we think, not needing a very particular description. We do not see any thing in this apparatus which can render it superior to some of its predecessors, most of which have had their day, and are not now heard of.

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35. For a portable *Apparatus for Purifying Carburetted Hydrogen Gas, produced from wood*, for illumination; Daniel Garret, Richfield, Otsego county, New York, June 27.

This is a "portable apparatus for the purification of carburetted hydrogen gas, produced from wood, for the purpose of illumination, which apparatus is to be employed as an article of domestic economy, the gas being produced by the fires used in cooking stoves, or for



other purposes." Within a metallic cylinder, containing water, two condensing cylinders of metal are placed, side by side, the top of the outer cylinder serves to close the upper ends of the two condensing cylinders; the lower ends of these latter terminate within a short distance of the bottom of the outer cylinder; the water in the latter surrounds the condensing cylinders; cylinders of wood occupy a large portion of the interior of the condensing cylinders, and through perforations contained in one of these, the gas, generated in a retort, or vessel, exposed to the action of the fire within the stove, is to pass through a pipe. The space between the wooden, or metallic cylinder, receives the gas, and the pyrolignous vapour is, in part, condensed, and deposited in it; the gas passes thence into the next condenser, where its purification is to be completed. From this it is to pass through a pipe at the top, to the burner or burners; suitable pipes lead from the bottom of the condensers for the discharge of the condensed fluid, &c. The claim is to the manner in which the outer cylinder containing water, the condensing cylinders, and the inner cylinders have been arranged and combined for the purpose specified. The gas made by an apparatus of this kind may be used for a time, as a matter of amusement, but it will be defective in quality, troublesome to prepare, and without economy in use, and its fate, therefore, may be foretold.

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36. For a *Seed Planting Machine*; Thomas J. and George F. Lewis, Boston, Massachusetts, June 27.

This seed planter is one of the kind in which the seeds are received in holes made through the face of a wheel revolving horizontally, at the bottom of the hopper. A machine similar to this, except in some slight modifications to which the claim is confined, was patented to Martin and Samuel L. Seward, on the 27th of July, 1839, and is noticed in this journal, vol. xxvi, page 118. The claim to the proposed improvement could not be understood without a more full description than we think it necessary to give, and probably not without drawings.

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37. For improvements in the *Percussion and Re-action Water Wheel*; Zebulon Parker, of Newark, Licking county, Ohio, and Robert M. Kelvey, of Portage county, Ohio, Administrator of the late Austin Parker, deceased, June 27.

This patent has been obtained for improvements on a water wheel, patented by Zebulon and Austin Parker, on the 19th of October, 1829, and noticed in the 5th volume, page 33, of the new series of this journal.

"The percussion and re-action wheel, or wheels, whether on a horizontal or a vertical axis, or shaft, is enclosed in a box, or case, which is denominated a draft, which draft is made air and water-tight at the top and sides, but it is without a bottom, the mouth of said draft dipping into the water, and being, whenever the mill is running, below the level of the water in the tail race; its action in this case

will be like that of any air and water-tight box having one side open, and that side placed downwards, so that its edges shall dip into water; that is to say, if such box be filled with water, it will remain full, provided its altitude above the surface of the water be not greater than that of a column, which will be sustained by atmospheric pressure. The water which passes into these air-tight cases, or drafts, passes in through the percussion and re-action wheels. "What is claimed as new in the above described improvement on the percussion and re-action water wheel, as originally patented by Z. and A. Parker, is the placing of the said wheel, or wheels, or of wheels analogous thereto in their construction and mode of operation, within air and water-tight cases, or boxes, herein denominated drafts, substantially in the manner, and for the purpose above set forth."

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38. For an improvement on the *Screw Wrench*: Henry W. Hewet, New York City, June 27.

On the main bar between the handle and the fixed jaw is placed a revolving tube, one end being made octagonal, by which it is turned, and the remainder having a male screw cut upon it, which fits into a nut attached to the movable jaw. As the tube is turned to the right or left, the movable jaw is moved towards, or from, the fixed jaw.

The claim is confined to the cutting of the male screw upon the tube which revolves upon the main bar, in combination with the nut attached to the movable jaw.

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39. For a machine for *Breaking Stone, employed in making Roads, &c.*: Nicholas Cooper, Sr., Townsend McConnel, and William E. Lukens, the two former of Wheeling, Ohio, and the latter of Short Creek, Harrison county, Ohio, June 27.

A revolving cylinder has around its periphery a series of hammers, either fixed or swinging; and these hammers, as the cylinder revolves, pass between a series of short bars standing at right angles to it, and having their ends nearly in contact with it; they extend out in a line nearly horizontal with its axis, and embrace, by their depth, about one-fourth of its circumference.

The stones to be broken, are thrown into a hopper, whence they pass down an inclined plane, and come into contact with the revolving hammers, by which they are beaten, and are made to fly upwards, against what the patentees denominate a battery, from which they rebound, and are again struck by the hammers; and this continues until they are reduced to a size which will admit of their falling through the grating.

The claim is confined to the combination of the rotary hammers, fixed, or swinging, with the bars, and the combination of these with the grating and the battery.

Various attempts have been made to break stone for the making of roads, by means of machinery, but we are not aware that any such machine has been continued in use; should that before us be destined

to establish its character for usefulness, it will do more than we expect from it.

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40. For improvements in the *Seed Planter*; Thomas J. and George F. Lewis, Boston, Massachusetts, June 27.

This patent is for improvements on the kind of seed planters in which the seed is distributed and dropped by apertures in a horizontal wheel placed at the bottom of the hopper, like that above noticed as having been patented by the same persons, and bearing the same date with that now under consideration. The modifications claimed under this patent, consist in the peculiar arrangements of the hopper and of the dropping apertures in the wheel, and likewise in the mode of arranging the gearing by which the parts are operated. As the claims refer to, and could not be understood without the drawings thereof, we omit them.

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41. For an improved method of *Hydrographic and Topographic Surveying*; H. Ariel Norris, City of New York, June 27.

We will merely quote from the specification those portions of it in which the patentee expresses the nature of his invention, and what he claims as new, viz: "The nature of my invention consists in a greatly facilitated system of triangulation; the angles being measured from the extremities of one or more base lines to a moving flag, (or other mark,) simultaneously, and at regular intervals of time; one chronometer (or other time-keeper,) governing the measurement of angles upon the base lines, and another, set to the first, governing the soundings and other examinations of the party accompanying the moving flag, on land, or on water." "What I claim as my invention, and desire to secure by letters patent, is as follows. 1st. The method herein described of enabling the bearing angles of the boat, or moving body, to be taken, at the same instant, from the extremities of one or more base lines, by the use of time-keepers and signals, arranged and operated upon the principles herein set forth—the principal object of which arrangement is to determine the boat, or moving body's position without stopping its progress, thus executing the survey more rapidly. 2nd. In combination with the foregoing, the method herein described of enabling the soundings (or other notices and examinations of the surveyor accompanying the moving body,) to be made at the same instant the angles are taken, by the employment of a time-keeper, for ascertaining the times, previously agreed on, at which the soundings (or other examinations,) should be taken, and the angles measured."

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42. For a mode of *Sawing or Cutting Snags*; James Hamilton, New York City, June 27.

This patent is obtained for a mode of arranging a saw, and connecting it with the necessary machinery, placed in a boat, or scow; the saw is made capable of being placed at any desired inclination, to cut in any direction, and at any desired depth under water. Said



saw is attached to the end of an arm, which slides in a frame, and is actuated by a crank. The manner of arranging the respective parts cannot readily be described without drawings, and as the machine, should it prove to be useful, will not be one of general interest, we are not disposed to afford the space which would be required, were we to attempt the description. We are the less inclined to this, however, because we think that the machine will not prove to be one of utility; not from want of skill in the inventor, but from difficulties which are inherent, namely, the unavoidable mobility of the vessel within which the machinery must be placed. The claim is to the above arrangement by which the saw can be placed to cut at any inclination.

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SPECIFICATIONS OF AMERICAN PATENTS.

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*Specification of a Patent for a Cooking Stove. Granted to WILLIAM GALLUP, Norwalk, Huron county, Ohio, June 10th, 1840.*

To all whom it may concern: Be it known that I, William Gallup, of Norwalk, in the county of Huron, and State of Ohio, have invented an improvement in the manner of constructing cooking stoves. I do hereby declare that the following is a full and exact description thereof. [References to drawings have been omitted.]

The fire chamber is connected with the main body or oven part of the stove, by a flat flue, which extends the whole width of the stove, and slides back and forth, and is capable of being passed entirely into the upper portion, or flue, of the main body, or oven part of the stove, so as entirely to close the space formed by the front of the body of the stove, and the back of the fire-chamber, when it is drawn forward. The fire-chamber extends down, so as to rest and slide upon the bottom plate of the stove, and has openings, or grate bars, in front, and extending down on its lower side for the admission of air, as in the ordinary open grate, the ashes from which fall into the ash-pit, or sink, in the bottom plate. I make four boiler holes in the top plate of the sliding part of my stove, and the same number in the top plate of the main body, and these are so arranged as that when the front portion is slid in, its two rear holes will coincide with the two forward holes, in the top plate of the main body.

When the fore part is drawn out, there will be a space formed between the two portions, having on one side of it the back plate of the fire-chamber, on the other, the fore plate of the oven flue, and at the top, the flue, by which arrangements this space is admirably adapted to the purpose of roasting, heating, and other cooking operations, and is intended to receive a tin, or other roaster, of any convenient form. The oven in the main body of the stove is surrounded by flues at four of its sides, the draught passing over a plate extending from the throat over the oven around the end of this plate, between it and the top of the oven, down the front of the oven, under the oven, and up the

back. There is a damper to open a direct communication from the fire-chamber to the exit pipe, when desired, as in many other stoves.

Having thus fully described the construction, and the mode of using, my stove, what I claim therein as of my invention, and desire to secure by letters patent, is the forming of a baking compartment between the back plate of the fire-chamber and the front plate of the main body of the stove, by arranging the oven below the throat of the furnace, in the manner described, instead of above it, as heretofore, by which means a radiating surface is presented at the back of the compartment.

WILLIAM GALLUP.

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*Specification of a Patent for Ponton Equipage, for the use of Armies. Granted to E. M. HUNTINGTON, Terre Haute, Indiana, Administrator of the Inventor, JOHN F. LANE, deceased, late Colonel in the Army of the United States, June 17th, 1840.*

To all whom it may concern: Be it known that John Foote Lane, late a Colonel in the Army of the United States, of the State of Indiana, now deceased, did, during his life time, invent a new and useful ponton equipage, or apparatus, which equipage, or apparatus, is intended, principally, for the purpose of constructing ponton bridges for the use of armies, and which is also serviceable in the formation of floating batteries and rafts, and for other purposes in military operations. And I, Elisha Mills Huntington, administrator of the estate of the late decedent, do hereby declare that the following is a full and exact description of the said ponton equipage, or apparatus.

Instead of the boats ordinarily employed in the construction of ponton bridges, pontoons, or floats, are made of stout sail duck, or other suitable material, which is rendered impervious to air and moisture, by being coated, or saturated, with India rubber, or in any other adequate manner. The material used is to be made into pontoons, or floats, of such size as may be considered necessary to adapt them to the particular purpose to which they are to be applied. That which has been most used is in the form of a cylinder, of about eighteen feet in length, and two feet in diameter, when inflated, or filled with air. Although these pontoons, or floats, may be made, or constructed, in different modes, that which has been found most eligible, as uniting strength with convenience, is the following. They have been made of three thicknesses of stuff; the interior, or lining, and also the second layer of material, has been of Russia sheeting, of the best quality; and No. 1 Russia twine duck, (hemp,) or some other equally good fabric, has been used for the outer layer. Each of these layers has been coated with the prepared India rubber, applied thereto by the proper machinery, in such way as completely to saturate it. In forming the ponton, the inner, or lining, thickness of duck is put together with the side on which the India rubber is applied, outwards; the stuff should be so cut as that the ends shall be hemispherical. The joinings are secured by means of strips of the same material coated with India

rubber on both sides; these strips should be about five inches wide. At one end, or at both ends of this, a flexible air-tube, or piping, is to be inserted, through which the ponton is to be inflated. The ends of these tubes are furnished with metallic terminations, having suitable caps, or valves, for the proper management of the inflating process. The second layer of material is now to be applied on the first, and this is prepared by being coated perfectly on both sides with India rubber. In applying this, care is taken to break joints, and to connect it with, and along, the air, or inflating, tube, leading into the interior. The third, or outer layer of material, is then put on; this is covered with India rubber on that side only which is in contact with the second layer, but this material is so applied to it as to be driven well through its fibres; this also is attached to, and covers, the air-tube.

For the purpose of making the requisite attachment to the pontons, they are to be embraced, both longitudinally and transversely, by strong bands of the same, or other suitable material, which bands, at the ends and sides of the pontons, are to be formed into loops, in the manner hereinafter shown. These bands have been made six inches wide, and like the pontons, of three thicknesses of stuff. There may be two bands made to run longitudinally, and these are formed into loops at each end of the ponton; and five such bands have been made to surround them. The loops left on each side of the pontons may measure about a foot. These loops should be stitched with strong twine, or thread, close to the pontons, so as to render them secure against the strain to which they will be subject. All this having been properly done, the pontons are ready for inflation at any time, which may be effected by the common Smith's bellows, or by a suitable force or condensing pump.

To form a bridge over a stream with these pontons, having provided the requisite string-pieces and plank, first inflate a sufficient number of the pontons, then place one of them in the water, parallel with the bank of the stream, and by three string-pieces, so that their outer ends reach the centre of the ponton; then shove the ponton into the stream, the length of the string-pieces, which may be fourteen feet, more or less—place another ponton under the string-pieces next the shore, lay plank upon this section of the bridge, add the next set of string-pieces, connecting the string-pieces of the respective sections, by means of iron clasps, or by dovetails, or otherwise. Where the strength of the stream requires it, guy ropes must be attached to the ends of the pontons, and to the river bank, so as to keep the pontons in their proper places; and in this manner until the bridge reaches the opposite bank of the river. Any number of such pontons may be connected together, when requisite, so as to constitute a floating battery, or float, or raft, for the transportation of armies, baggage, or troops, instead of a bridge, this may be effected by placing them side by side, and passing poles through the loops, and then covering the whole with plank, or not, according to the nature of the service desired.

Other forms than that of the cylinder may, it is manifest, be given to the respective pontons. They have sometimes, for example, been



made in the form of an ordinary pillow, and two, three, or more of them have been connected together, so as that their greatest width were in a vertical direction, and thus confined together by loops and poles, or otherwise. Their ends, in this case, have been formed like the bow of a boat, or canoe, so that when made to constitute a float, or raft, their passage through the water has been smooth and easy. It will be evident that such pontoons may be so constructed as to assume the form of a boat, or any other figure that may be found necessary or convenient, and they may be made of one, two, three, or more cylinders, attached. Where there is danger from the attack of an enemy, great security will result from the combining of two, three, or more, of such pontoons, to support the ends of the string-pieces of a ponton bridge, as the perforation of one, or two, by balls, or otherwise, may still leave the structure sufficiently secure.

Having thus fully described the nature and object of the invention made by the late Colonel John Foote Lane, and shown the manner in which the same is to be used; what is claimed as new therein, is the constructing of ponton bridges, by combining together the pontoons, such as herein described, and the necessary string-pieces and planking, as set forth, and also the combining together of such pontoons as herein described, so as to form floating batteries, or floats, or rafts, for the conveyance of arms, or troops, or for other purposes, appertaining to military operations.

E. M. HUNTINGTON.

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#### SPECIFICATIONS OF ENGLISH PATENTS.

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*Specification of a Patent granted to WILLIAM HICKLING BENNETT, of London, for Improved Machinery for Cutting and Working Wood. December 24th, 1840.*

The improvements comprehended in this patent are—Firstly, a new system of guides for boards while passing through the wood-cutting machines. The iron frame of the guides varies in shape in different machines; it forms a bed on which the guides traverse. The guides are formed of puppet-heads in pairs, one being fixed, the other movable, in order to hold and guide wood of different sizes. Movable pieces slide over the inner vertical faces of the guides, and pressing down upon the upper surface of the wood it is thus held firm and steady.

Secondly, an improved mode of elevating and depressing the upper pair of rollers, when the wood is carried forward by their means. The axes of the upper rollers turn in blocks which slide up and down in grooves in the upright side frames of the machines. They are regulated by spur and bevel wheels, in conjunction with spiral springs, so that while the wood is finally held, an elasticity is obtained by means of the springs, which allow any irregularities in the surface of wood to pass through the rollers.

Thirdly, an improved mode of admitting oil to the working parts,

viz: the circular saws, shafts, spindles, &c. consisting of a cup with a tube at the bottom furnished with a stop cock, to be so adjusted as to allow any number of drops per minute to fall from the nipple into the channel leading to the bearings requiring lubrication.

Fourthly, an improved mode of sawing and dividing wood, so as to effect the planing at the same time; the arrangement being also applicable to veneer saws.

For this purpose, there are slots near the periphery of the circular saws, approaching as near to the edge as is consistent with due strength; in these slots side cutters are fixed, with their edges ground and set to the same angle as a plane iron. These cutters project slightly beyond the set of teeth of the saw; so that a shaving is continually taken off as the saw revolves. Or the edges of such slots in the saw plate may be turned up and used in lieu of detached cutters.

Fifthly, the application of the foregoing construction with two or more sets of circular cutters, so as to form two or more strips of plain or ornamented moulding. To accomplish this, two or more circular saws are mounted on one spindle between which, instead of washers, blocks are fixed, holding the cutters in their upper edges. These are circular and may be either plain or moulded, and they project sufficiently to perform the necessary operation as rapidly as the circular saws can rip the scantlings or boards into strips.

Sixthly, an improved mode of forming moulding and other cutters. These cutters may be of any required shape, and are attached to blocks, fixed on the saw spindle by grooves and feathers. They are made of thin steel plates, screwed between two metal plates, which are worked down on each side so as to leave the steel edge projecting about  $\frac{1}{20}$  of an inch.

Seventhly, a machine for preparing deals and haulks of timber for sawing. The wood to be operated upon is laid on a metal bed moved by a rack and pinion and slides on V pieces fixed to the floor. The apparatus for holding the timber is firmly secured to this bed; puppets are screwed to the sliding bed, their inner faces being made perfectly true. To these faces a cast-iron beam is attached vertically, so that it can be moved up and down, by nuts and screws, and serves to clip the upper part of the piece of timber.

The holding parts are capable of adjustment, so that timbers of any size may be held on different sides quite firmly, and brought up to the cutters by the traversing bed, for preparing a flat or square side thereto.

Eighthly, a machine for the same purpose, which may also be used for cutting mouldings or cornices and skirting-boards.

The wood in this case is secured to a traversing table and moved forward by a chain, rack and pinion, or other convenient means. Circular cutters are made to revolve above it, which strike the required pattern on the edge of the wood as it advances.

Ninthly, another machine for the same purpose, only in this case the machinery with the cutters approaches the wood instead of the wood approaching the cutters. This consists of a movable bed traver-

sing upon a fixed one; this bed carries the cutters with their driving wheels, &c. The wood is held upon a raising and falling table, while the machinery, cutters, &c. on the traversing bed are made to approach and perform the required operations on its surface and edges.

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*Specification of a Patent granted to FELIX TROUBAT, for improvements in the Manufacture of Vinegar. February 1, 1841.*

To 350 lbs. of raw potatoes, well rasped, are added from 20 to 25 gallons of water and 2 lbs. of sulphuric acid; this mixture is to be boiled for six hours, and then run off into a cooler, through a perforated plate or strainer, to free the liquor from sediment, and afterwards transferred to another vessel placed in a chamber of a temperature of 80° of Fahrenheit. One ounce of potash dissolved in water, and half a bushel of yeast are added to the liquor; at the expiration of three days a further quantity of yeast is added to increase the fermentation. A vessel is loosely filled with shavings of beech, or the skins of pressed grapes saturated with strong vinegar. Three gallons of the fermented liquor are poured in, mornings and evenings, till the vessel is filled. It is then drawn off, three gallons at a time, from the bottom of the vessel, and poured into another vessel half filled with perfect vinegar, from which it is removed into another loosely filled with beech shavings to cool and clear it, which renders it fit for use. Another process consists in pouring 50 gallons of boiling water upon 350 lbs. of potatoes that have been well crushed and washed, and allowing it to stand until it assumes the consistence of a thick paste, when half a bushel of meal of malt is added to bring it into a saccharine state; it is then submitted to the process of fermentation, &c., as before described.

In another process, 50 or 60 pounds of ground rice is used in lieu of the potatoes, and treated according to the directions first given. The patentee does not confine himself to any of these precise proportions, but claims, 1. The mode of making vinegar by the application of potatoes. 2. The mode of making vinegar by the application of rice as described.





# METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

FEBRUARY, 1841.

| METEOROLOGICAL REPORT                                                                                                   |                 |                       | Thermometer. |         |          |          |          |       |               |         |       |               | Barometer. |         |          |          |          |       |               |        |         |               | Weather. |       |                |                  |                 |        |       |       |          |          | Winds. |        |          |       |          |       |          |       |          |       | Hygrometer.   |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------|--------------|---------|----------|----------|----------|-------|---------------|---------|-------|---------------|------------|---------|----------|----------|----------|-------|---------------|--------|---------|---------------|----------|-------|----------------|------------------|-----------------|--------|-------|-------|----------|----------|--------|--------|----------|-------|----------|-------|----------|-------|----------|-------|---------------|------------|---------------|-----------------------------|-----------|---------------|----------------|--|------|--|--|--|--|--|--|--|--|--|--|--|
| FOR THE STATE OF PENNSYLVANIA,                                                                                          |                 |                       |              |         |          |          |          |       |               |         |       |               |            |         |          |          |          |       |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| Collected from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for |                 |                       |              |         |          |          |          |       |               |         |       |               |            |         |          |          |          |       |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| FEBRUARY, 1841.                                                                                                         |                 |                       |              |         |          |          |          |       |               |         |       |               |            |         |          |          |          |       |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| Countv.                                                                                                                 | Town.           | Observer.             | 7. A. M.     | 2 P. M. | 9. P. M. | Maximum. | Minimum. | Mean. | Days omitted. | Lowest. | Mean. | Days omitted. | 7. A. M.   | 2 P. M. | 9. P. M. | Maximum. | Minimum. | Mean. | Days omitted. | Clear. | Cloudy. | Days omitted. | Rain.    | Snow. | Rain and Snow. | Hail or Showers. | Rain in inches. | North. | N. E. | N. W. | E. N. E. | E. S. E. | S. E.  | South. | S. S. W. | S. W. | W. S. W. | West. | W. N. W. | N. W. | N. N. W. | Calm. | Days omitted. | Dew-point. | Days omitted. | Dull, storm, and dew-point. | Wet bulb. | Days omitted. | No. of Report. |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 1 Philadelphia.                                                                                                         | Philadelphia.   | G. P. Schveley.       | 30.93        | 36.73   | 30.68    | 32.50    | 4.50     | 32.79 |               | 3.00    | 27.93 |               | 29.98      | 29.98   | 29.97    | 30.33    | 29.43    | 29.98 |               | 154    | 123     |               |          |       |                |                  |                 | 1      | 2     | 53    |          |          |        |        |          | 53    | 13       | 4     | 53       | 23    |          |       |               |            |               |                             |           |               | 1384           |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 2 Montgomery.                                                                                                           | Newtown.        | L. H. Parsons.        | 24.10        | 35.13   | 26.84    | 49.00    | 2.00     | 28.69 |               | 1.75    | 21.40 |               | 29.95      | 29.94   | 29.96    | 30.55    | 29.43    | 29.95 |               | 104    | 163     | 1             | 2        | 2     |                |                  | 1.308           | 13     | 4     | 44    |          |          |        |        | 4        | 3     | 39       | 1     | 83       | 1     | 1        | 2     |               |            |               |                             |           |               | 1497           |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 3 Bucks.                                                                                                                | Easton.         | Charles Elliot.       |              |         |          |          |          |       |               |         |       |               | 29.39      | 29.44   | 29.48    | 29.70    | 29.10    | 29.42 | 83            | 5      | 11      | 12            |          |       |                |                  |                 | 13     |       | 13    |          | 1        |        |        |          | 4     |          | 63    |          | 23    |          |       | 103           |            |               |                             |           |               | 1391           |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 4 Lehigh.                                                                                                               | Stonesburg.     | A. M. Stokes.         | 15.04        | 32.83   | 17.50    | 44.00    | -11.00   | 18.46 | 133           |         |       |               | 29.39      | 29.44   | 29.48    | 29.70    | 29.10    | 29.42 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 5 Northampton.                                                                                                          | Mifflin.        | Ralph Bull.           |              |         |          |          |          |       |               |         |       |               | 28.66      | 28.65   | 28.66    | 29.00    | 28.25    | 28.66 |               | 194    | 83      |               |          |       |                |                  |                 |        | 53    |       | 43       |          | 13     |        |          |       |          |       | 13       | 123   |          | 1     |               |            |               |                             |           |               |                |  | 1393 |  |  |  |  |  |  |  |  |  |  |  |
| 6 Monroe.                                                                                                               | Stroudsburg.    | W. Richardson.        | 14.56        | 29.43   | 16.51    | 46.00    | -8.00    | 20.22 |               | -20.00  | 8.86  |               | 27.99      | 27.98   | 27.98    | 28.30    | 27.52    | 27.98 |               | 73     | 203     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 7 Pike.                                                                                                                 | Malford.        | E. Rose.              | 19.89        | 29.07   | 24.04    | 50.00    | -2.00    | 24.33 |               |         |       |               | 27.99      | 27.98   | 27.98    | 28.30    | 27.52    | 27.98 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 8 Wayne.                                                                                                                | Hoe-e-dale.     | W. F. Dennis.         |              |         |          |          |          |       |               |         |       |               | 29.39      | 29.39   | 29.39    | 29.86    | 28.21    | 29.18 |               | 13     | 15      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 9 Susquehanna.                                                                                                          | Silver Lake.    | C. F. Eggenmann.      | 17.79        | 38.57   | 21.80    | 52.00    | -13.00   | 26.05 |               | -15.00  | 12.25 |               | 29.19      | 29.19   | 29.19    | 29.86    | 28.21    | 29.18 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 10 Luzerne.                                                                                                             | Wilkesbarre.    | P. C. Lyceum.         | 21.94        | 32.75   | 25.07    | 46.00    | 00.00    | 26.59 |               | -4.00   | 17.80 |               | 29.70      | 29.68   | 29.71    | 30.1     | 29.20    | 29.70 |               | 123    | 153     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 11 Berks.                                                                                                               | Port Carbon.    | C. F. Eggenmann.      | 17.79        | 38.57   | 21.80    | 52.00    | -13.00   | 26.05 |               | -15.00  | 12.25 |               | 29.19      | 29.19   | 29.19    | 29.86    | 28.21    | 29.18 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 12 Chester.                                                                                                             | West Chester.   | Wm. W. Jeffries.      |              |         |          |          |          |       |               |         |       |               | 29.80      | 29.80   | 29.80    | 29.80    | 29.44    | 29.80 |               | 15     | 13      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 13 Delaware.                                                                                                            | Haverford.      | Haverford School.     | 29.86        | 36.73   | 32.64    | 49.00    | 14.00    | 33.08 | 6             | 00.00   | 20.37 |               | 29.43      | 29.38   | 29.41    | 29.70    | 28.92    | 29.41 |               | 1      | 173     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 14 Lancaster.                                                                                                           | Lancaster.      | Conservatory of Arts. | 24.68        | 36.39   | 27.16    | 54.00    | 3.00     | 29.41 |               | 2.00    | 22.43 |               | 29.32      | 29.29   | 29.32    | 29.73    | 28.79    | 29.31 |               | 15     | 13      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 15 Lebanon.                                                                                                             |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.69      | 29.65   | 29.70    | 30.07    | 29.22    | 29.68 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 16 York.                                                                                                                | Harrisburg.     | J. Heiseley.          | 25.04        | 31.44   | 29.63    | 44.00    | 5.00     | 28.70 | 3             | 5.00    | 22.14 |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               | 3      | 193     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 17 Schuylkill.                                                                                                          | Northumberland. | Andrew C. Huston.     | 19.00        | 34.59   | 24.18    | 52.00    | -9.00    | 25.86 |               | -13.00  | 13.68 |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               | 83     | 193     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 18 Columbia.                                                                                                            | Danville.       | C. H. Frick.          |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 19 Bradford.                                                                                                            |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 20 Tioga.                                                                                                               |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 21 Lycoming.                                                                                                            |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 22 Union.                                                                                                               |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 23 Mifflin.                                                                                                             |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.30      | 29.26   | 29.30    | 29.65    | 28.75    | 29.29 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 24 Juniata.                                                                                                             | Mifflintown.    | J. A. Kinkead.        | 18.79        | 35.88   | 28.80    | 50.00    | 00.00    | 25.82 | 13            |         |       |               | 29.34      | 29.36   | 29.34    | 29.76    | 28.82    | 29.35 | 13            | 83     | 18      | 13            |          |       |                |                  |                 |        | 1     |       | 13       |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 25 Perry.                                                                                                               |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.34      | 29.36   | 29.34    | 29.76    | 28.82    | 29.35 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 26 Cumberland.                                                                                                          | Carlisle.       | Prof. W. H. Allen.    |              |         |          |          |          |       |               |         |       |               | 29.33      | 29.34   | 29.33    | 29.56    | 28.78    | 29.33 | 13            | 13     | 13      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 27 Adams.                                                                                                               | Gettysburg.     | Prof. M. Jacobs.      | 21.93        | 35.07   | 26.69    | 50.00    | -4.50    | 27.56 |               | -4.50   | 19.16 |               | 29.33      | 29.34   | 29.33    | 29.56    | 28.78    | 29.33 |               | 13     | 13      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 28 Franklin.                                                                                                            | Huntingdon.     | Prof. Jacob Miller.   | 19.88        | 36.00   | 24.71    | 49.00    | -13.00   | 26.86 |               |         |       |               | 29.18      | 29.16   | 29.18    | 29.56    | 28.68    | 29.17 |               | 16     | 12      |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 29 Centre.                                                                                                              | Bellefonte.     | John Harris.          |              |         |          |          |          |       |               |         |       |               | 29.18      | 29.16   | 29.18    | 29.56    | 28.68    | 29.17 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 30 Potter.                                                                                                              |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.18      | 29.16   | 29.18    | 29.56    | 28.68    | 29.17 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 31 McKean.                                                                                                              | Smithport.      | M. R. Atkins.         | 17.63        | 27.19   | 20.82    | 40.00    | -10.00   | 21.88 | 3             |         |       |               | 29.18      | 29.16   | 29.18    | 29.56    | 28.68    | 29.17 |               | 11     | 163     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 32 Clearfield.                                                                                                          |                 |                       |              |         |          |          |          |       |               |         |       |               | 29.18      | 29.16   | 29.18    | 29.56    | 28.68    | 29.17 |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 33 Cambria.                                                                                                             | Ebensburg.      | Richard Lewis.        | 18.21        | 28.59   | 21.29    | 43.00    | -7.00    | 22.70 | 3             |         |       |               | 27.62      | 27.63   | 27.63    | 28.00    | 27.23    | 27.63 |               | 7      | 193     | 13            |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 34 Bedford.                                                                                                             | Bedford.        | Samuel Brown.         | 22.58        | 35.83   | 26.61    | 49.00    | 00.00    | 28.27 |               |         |       |               | 29.05      | 29.04   | 29.06    | 29.00    | 28.00    | 29.05 |               | 94     | 183     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 35 Somerset.                                                                                                            | Somerset.       | George Mowry.         | 22.94        | 31.54   | 25.76    | 45.00    | 0.00     | 26.79 | 34            |         |       |               | 27.67      | 27.68   | 27.69    | 28.01    | 27.30    | 27.68 | 34            | 8      | 163     | 31            |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 36 Indiana.                                                                                                             | Indiana.        | Richard White.        | 26.31        | 32.88   | 24.04    | 47.00    | -8.00    | 27.73 | 2             |         |       |               | 28.40      | 28.43   | 28.42    | 28.80    | 28.40    | 28.42 | 2             | 11     | 15      | 2             | 1        | 10    |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 37 Jefferson.                                                                                                           | Rose Cottage.   | C. C. Gaskell.        |              |         |          |          |          |       |               |         |       |               | 28.52      | 28.61   | 28.54    | 28.97    | 28.10    | 28.56 |               | 43     | 133     |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 38 Warren.                                                                                                              | Warren.         | J. E. King.           | 27.79        | 35.89   | 22.47    | 39.00    | 1.00     | 28.72 |               |         |       |               | 28.78      | 28.79   | 28.81    | 29.20    | 28.00    | 28.79 | 11            | 7      | 194     | 14            |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |
| 39 Franklin.                                                                                                            | Franklin.       | Wm. Connelly.         | 16.00        | 33.32   | 23.25    |          |          |       |               |         |       |               |            |         |          |          |          |       |               |        |         |               |          |       |                |                  |                 |        |       |       |          |          |        |        |          |       |          |       |          |       |          |       |               |            |               |                             |           |               |                |  |      |  |  |  |  |  |  |  |  |  |  |  |

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**JOURNAL**  
OF  
**THE FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**

SEPTEMBER, 1841.

**Civil Engineering.**

*Extracts from the Treatise on Geodesy, by L. B. FRANÇOEUR. Translated by W. H. EMORY, Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 23.]

*Book 2nd.—Geomorphy.*

GEOMORPHY, more commonly called GEODESY, is the science which treats of the measurement of the earth, and its great territorial divisions. The results in geomorphy are obtained by observations and calculations. Therefore, as a preliminary step, it is necessary to be made acquainted with the instruments which are used, and the formulas applicable to the observations made with them.

For this reason, we shall commence by giving the theory of these formulas, and a brief description of two instruments with which the observations are usually made. The theory of these formulas, which are of constant application, is comprised in the article on *spherical trigonometry*.

Operations in geomorphy consist in the measurement and calculation of angles and distances on the surface of the earth, and in the observation of stars, to determine from them the relative position of places. Hence the two great divisions of the subject into *terrestrial* and *astronomical geomorphy*.

The terrestrial operations consist in covering the whole ground to be explored with a series of triangles, the angles of which are measured with an instrument, and the sides calculated; one of the sides

being taken as a *base*, and measured by direct means. After this is done, we can derive from it the extent of the terrestrial arcs which lie within these triangles, such as the *meridian*, and the *parallel of latitude*. These arcs being known, serve to determine the ellipsoidal form, and the dimensions, &c., of the terrestrial globe.

The astronomical operations enable us to find the *longitude* and *latitude* of stations, the *azimuth* of the sides of triangles, the variation of the needle, &c.

Many other subjects are treated of in this book besides those enumerated, which are immediately applicable to geodesic operations. Some of which are—

1st. The oscillations of the *pendulum*, which furnish very useful data in determining the oblate form of the earth.

2nd. The elevation of points which are taken as geodesic stations, or in other words, the method of *leveling*.

3rd. The art of representing by figures the results arrived at by the foregoing methods; that is to say, the art of composing a *geographical map*, which enables the eye to embrace, and compare, at the same time, all the details; for it is not sufficient for the purposes of geography, to have merely the numerical values deduced from the determination of the sides of the triangles with which we cover a district of country to be surveyed.

## CHAPTER II.—*The Repeating Circle.*

The repeating circle gives results with great precision, and is the most ingenious of all the instruments used in measuring angles. Since its invention by Borda, the large instruments used for terrestrial and celestial observations, the weight of which rendered their transportation and management so difficult, have been abandoned. Experience has shown that results can be obtained quite as accurately, and with much more rapidity, with a repeating circle of about three decimetres, [11.8113 inches,] in diameter. Figures 58 and 59 are representations of this useful instrument. In describing it, we limit ourselves to essential details; for the component parts are too complicated to be represented precisely by drawings. An examination of the instrument itself is the most satisfactory means of obtaining a knowledge of it.

We will give first the principles upon which the construction of the repeating circle is based.

93. It is a circle mounted on a tripod with a universal joint, by which it can be adjusted in the plane of any two objects between which it is proposed to find the angular distance, that is to say, the angle formed by visual rays drawn from the centre of the circle to

these objects. This circle turns on an axis perpendicular to its plane, and passing through its centre; so that in every position it takes in revolving about this axis, the objects, or signals, will be in the prolongation of the radii of the circle. This circle carries two telescopes movable around its centre; one of them, A A', (figs. 58 and 59,) above the limb, and the other, B B', below it.

The telescope A A', can be directed to any one object in the plane of the limb, and the telescope B B', to any other in the same plane, without moving the limb; the tubes of both telescopes revolving around its centre. It follows also that the circle, or limb, can revolve about the same axis, carrying with it the two telescopes. Each of these three movements is provided with a clamp and a tangent screw.

The construction of the telescopes will be described hereafter; for the present, it is sufficient to say that they are made with a magnifying power as great as the dimensions of the instrument will admit, and that in looking into the telescope we see two very fine threads intersecting each other at right angles, one parallel, and the other perpendicular, to the plane of the limb, with the point of intersection in the axis. To make an observation with the telescope, it is moved until the object is found in the optical field; this done, the delicate movements are produced, and the intersection of the threads brought in coincidence with the object by means of the tangent screw.

94. The limb is divided into degrees, half degrees, or less, according to the diameter of the instrument; usually, it is divided into divisions as small as five minutes. The upper telescope A A', has a vernier attached to it, which slides along in contact with the divisions of the limb. This vernier enables the observer, by the aid of a magnifying glass, to read the fractional parts of a division.

The theory of the vernier was explained in article No. 9; it was there shown that when an arc of the vernier, equal to  $n - 1$  parts of the limb, was divided into  $n$  number of equal parts, the space occupied by each division of the vernier was smaller than those of the limb by the  $n$ th part of the divisions on the latter. If, for example, the limb is divided into 360 degrees, and each degree divided into six equal parts, each part will be 10 minutes. If an arc of the vernier, equal to 59 of these divisions, be divided into 60 equal parts, each division of the vernier will be  $\frac{1}{60}$  or 10" smaller than those of the limb, and consequently the limb can be read to 10".

95. The upper telescope being placed in any position whatever, if we wish to read the corresponding graduation, we commence by reading the number of degrees, and the divisions of tens of minutes; then, if the zero point of the vernier falls between two divisional lines



on the limb, (as frequently happens,) there remains to be read on the vernier the fraction corresponding to the interval between the zero point of the vernier and the preceding divisional line of the limb. For this purpose, we observe what divisional lines of the vernier and the limb are in exact coincidence; then counting the number of divisions from this point to the zero point of the vernier, the number so obtained, multiplied by 10," will be the fraction required. To save the trouble of counting, these divisions are numbered, so that the number of minutes and seconds to be added to the first reading are indicated on the vernier.

The lower telescope does not move in contact with the divisional lines of the limb, and does not carry a vernier; its use will soon be explained.

96. The circle being mounted on the stand, and the limb being in the plane of the two signals, we fix the upper telescope on the zero of the graduation of the limb, and turn the circle upon the axis which is perpendicular to it, until the point of intersection of the cross hairs in the telescope  $A A'$ , is in coincidence with one of the signals  $L$ , (fig. 61.) The telescope is still fixed on the zero point of the limb. Fixing the limb in this position, direct the lower telescope upon the other object,  $K$ , to the left. The angle  $A C B$ , formed by the optical axes of the telescopes, is evidently the angle formed by visual rays from the centre of the circle to the two objects. This angle is measured by the arc  $A B$  of the circle intercepted by these two rays. But the telescope  $B B'$ , being below the limb, we cannot read the graduation.

Then turn the circle, and with it the telescopes, until the lower telescope, which was directed on the object  $K$ , situated to the left, takes the direction  $C A$ , on the object  $L$ , to the right; the upper telescope will thus be made to take the position  $C D$ , and the zero of the graduation on the limb will be moved from  $A$  to  $D$ . The value of the arc  $D A = A B$ , is the result required.

The circle being in the position last described, clamp it; then unclamp the upper telescope, and direct it on the object  $K$ , to the left. The angle  $B C A = A C D$ , is the one required; but the angle  $D A B$ , which we read on the limb, is double the required angle, it is therefore divided by two.

Repeat this double observation, by taking the point  $B$ , on the limb, as the point of departure, that is to say, turn the circle, together with the telescopes, until the upper one, which was in the position  $B B'$ , takes the position  $A A'$ , on the line of the right hand object; the zero of the graduation is thus moved from  $D$  to  $E$ , and the lower telescope passes from  $C A$  to  $C D$ . Now detach the lower telescope, and turn it (the limb being clamped,) until it is brought back on the object  $K$ ,

to the left, and the arc  $EB$ , will be triple the arc  $AB$ . Repeat again the same operation, by clamping the telescopes, and turning the limb until the lower telescope is directed on the object  $L$ ; the zero of the graduation is thus removed to  $F$ . Then detach, in its turn, the upper telescope, which is at  $CD$ , and move it until it is directed on the object  $K$ , to the left, and the arc  $FB$ , read on the limb, will be quadruple the arc required.

If we go on in the same manner, and make ten observations, the angle will be decupled. There is no necessity for reading the graduation at every observation with the upper telescope; it is sufficient to read the arc obtained when all the observations are completed.

We will now examine the advantages of measuring angles in this manner.

97. It is evident that if the upper telescope is brought back to the zero point of the graduation after ten observations, the sum of all the arcs is  $360^\circ$ , and each arc is  $36^\circ$ , and that the result is exempt from errors of eccentricity in the movement of the telescopes, and the errors in the division of the limb. It is proper to add that it seldom, if ever, happens in practice, that the upper telescope returns exactly to the zero point of the graduation; but if we find, after making ten observations, that the arc decupled is made  $320^\circ$  by some error of the instrument, when it should have been  $320^\circ 5'$ , we see that by dividing by 10, we get  $32^\circ$  instead of  $32^\circ 0' 30''$ , and that the error is reduced from  $5'$  to  $30''$ .

98. The repeating circle, when used with care and skill, has then this great advantage, that it diminishes the errors resulting from imperfection in the construction of the instrument, almost indefinitely. Besides, it lessens the errors resulting from not placing the cross threads and signals in coincidence.

To remedy the errors of eccentricity in the axis, it is customary to have two verniers attached to the superior telescope, diametrically opposite each other. The graduation of the limb corresponding to both verniers is read before commencing the observations, and after finishing them, for the purpose of seeing what space is passed over by the telescope; these arcs, if not exactly equal, will be nearly so, and the mean between them is taken. In the best instruments of this description, four verniers are used, placed at right angles to each other, and divided to read arcs of  $5''$  with exactness.

99. After what has been said, it is easy to form an idea of the construction of the repeating circle, (fig. 59.) The column  $S$ , is made with a slightly conical cavity in its longitudinal direction, in which the central axis of the instrument is inserted. This axis is of steel, and is firmly attached to a graduated circle, or plate,  $O$ . The column  $S$

carries with it the circle  $M M$ , which, with its telescopes, turns about this steel axis, its motion being stopped by the clamp screw  $O$ , which clamps the arm attached to the column  $S$ , to the lower plate  $O$ . The angular value of the general movement of the instrument about the axis can be read on this plate. The column should be adjusted exactly upon the axis of the central shaft, in order that the movement may be smooth and exact.

The plate carrying the axis is supported by three screws,  $v v' v''$ , which rest on the table  $N N$ . These screws are used to give slight inclinations to the column  $S$ . The table  $N N$ , is supported by three stout wooden legs, and in a prismatic opening in its centre a rod of the same shape is fitted, by raising or lowering which the table is raised or lowered to a convenient height to suit the observer. The circle is supported on the top of the column  $S$ , by an axis  $V$ , around which it revolves. This motion about the axis is stopped by a clamp screw  $P$ , which presses against a piece of brass in the shape of the quadrant of a circle, embracing the axis  $V$ .

To place the limb in the plane of two objects, the movement given to the column by the screws  $v v' v''$ , is combined with the movement of the circle about the axis  $V$ .

Some of these instruments are constructed with two axes perpendicular to each other, about both of which the circle may turn. The circle is easily placed in the plane of two objects by a combination of these two movements. In this construction, the column  $S$ , remains upright.

The vernier is usually attached to a circle carrying the telescope, and concentric with the graduated limb. This circle and the limb are apparently united. The faces of both are in contact, and in the same plane, and turn about the same centre. Each circle is supported on the axis by 6 or 8 spokes; the exterior one is divided on its inner side into  $360^\circ$ , and the interior one carries the verniers.

Perpendicular to the plane of these circles, and in their centre, is a steel axis, around which the two telescopes  $A A'$ ,  $B B'$ , revolve. Figure 59 shows the manner in which these telescopes should be arranged to be free and independent in their movements. This steel axis, or shaft, penetrates the centre of the bore of a cylinder which passes through the piece  $V$ , and is soldered to the centre of the *drum*  $T$ . When this drum is turned around its axis from  $X$ , towards  $T$  and  $Z$ , the vertical motion being stopped by the clamp screw  $P$ , it carries with it the limb and the two telescopes, without moving them from the plane of the two objects. The periphery of the *drum* is cut into notches, into which an endless screw works, and communicates slight motions to the limb in its plane. This screw is pressed against by a



steel spring, which being removable, the screw can be disengaged, and large movements communicated to the limb by the hand. The shaft of the drum should be exactly concentric with the limb and the arcs of the verniers.

100. To use the repeating circle, first place the limb  $MM$  in the plane of the two objects. Then, place the upper telescope on the zero of the graduation; disengage the drum  $T$  from the endless screw and revolve the limb until the upper telescope is directed on the object to the right. When the object is seen in the field of the telescope, re-attach the endless screw, and complete the contact of the object and cross hairs by the small movements of the drum. While this is being done, a second observer directs the lower telescope on the object to the left, and brings it in coincidence with the cross hairs. We have thus the first observation. One observer can perform both of these operations by doing them in succession, but with two the labour is abridged.

The 2nd observation of the angle is made by detaching the drum and turning the entire circle without detaching the limb, carrying with it both the telescopes until the lower telescope is directed towards the object to the right; at the same time the 2nd observer detaching the upper telescope, directs it towards the object to the left. When the first observer completes the coincidence of the cross hairs of the telescope with his object, by means of the drum-screw, the second observer completes his by the use of the tangent screw of the telescope. In the same manner the third, fourth, &c. measurement of the angle is made, each operator observing always on the same objects, but alternating with the telescopes. The arc indicated by the final observation is then divided by the number of measurements, and the quotient is the arc required.

101. It is frequently necessary to find the *angular height of a signal*, that is to say, the angle which a visual ray from the observer to the signal makes with the horizon. This angle is the complement of the angle which the same ray makes with a line from the observer to the zenith.

To measure the zenith distance, give the repeating circle the position represented in figure 58, by turning the drum on its shaft. Care must be taken to place a weight on the drum sufficient to counter-balance the weight of the limb and telescope, so that the centre of gravity may remain in the axis of the column  $S$ , which is placed exactly vertical. The last condition is attained by means of the spirit level, and the screws  $v v' v''$ , as will be explained hereafter.

Suppose now that the column and limb are exactly vertical, so that when the circle is turned, its plane shall be vertical in all its positions. The circle in figure 62 is supposed to represent the limb of the instru-

ment in one of these positions; the upper telescope is directed towards a signal H, the zenith distance of which is required. This distance is the angle formed by the visual ray C A with the vertical line C D. We suppose that the telescope has first been fixed at A upon the zero of the graduation, and that it has been directed on H by turning the drum in its plane, the column remaining fixed to the lower plate by the screw H, (see fig. 58.)

The instrument being in the position described, the screw H is loosened and the limb is turned with the column  $180^\circ$ . The telescope A' A will then take the position E' E, (fig. 62) and the zero point of the graduation the place E. But the line D D' will still remain vertical as the revolution is made about this line as an axis. Thus the angle to be measured is E C D. Detach the upper telescope and direct it exactly on the signal H, without deranging the position of the limb. It is evident that the arc A D is the one to be measured, and that the arc A E, described by the telescope is double the zenith distance required. This done, by turning the circle again, together with the shaft to the opposite side, the telescope returns to the position E E' and the observation is repeated as often as desired.

In this operation the lower telescope is no longer of any use, except to test, by means of a spirit level Q (fig. 58) fixed to it, the vertical position of the column, or rather of the diameter D D', after revolving the circle about it. This is done in the following manner:

102. After placing the limb and the column vertical, and fixing the telescope A B upon zero, turn the instrument about the column until the limb is in the vertical plane of the object: clamp the column by the screw O, and direct the telescope, which remains fixed at zero, upon the object by turning the limb on its horizontal axis by means of the drum screw. When the cross hairs and the object are in exact coincidence, turn the lower telescope, and by using its tangent screw, bring the bubble in the middle of the glass. Loosen the screw H and turn the instrument around the column S  $180^\circ$ , measured on the circle O. In this position of the instrument the object is still in the vertical plane of the limb, but on the opposite side.

The bubble should now be between the marks indicating the middle of the glass; if it is not, bring it to this place by turning the drum-screw, being careful not to touch the telescope or its tangent screw. Then detach the upper telescope and direct it on the signal: the angle passed over will be double the zenith distance. Observe exactly the place occupied on the limb by the upper telescope, which serves as a point of departure for a second observation. The second observation is conducted like the first, and repeated until the bubble remains in the middle of the glass in both positions of the instrument.

Fig. 58.

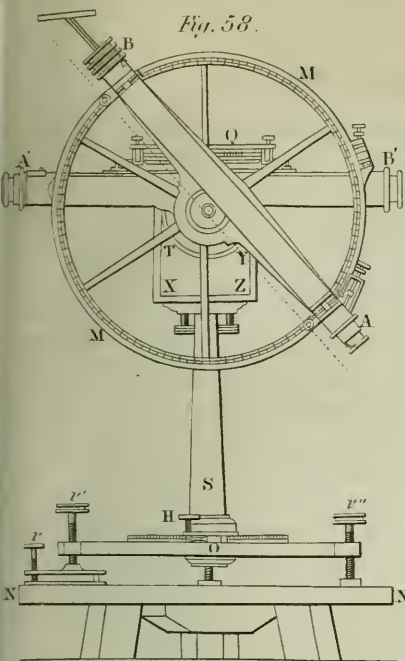


Fig. 59.

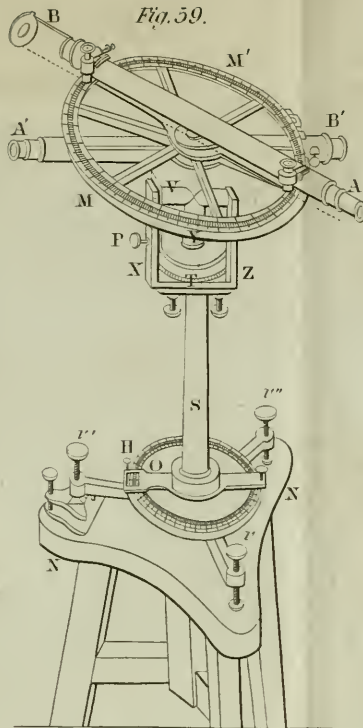


Fig. 70.

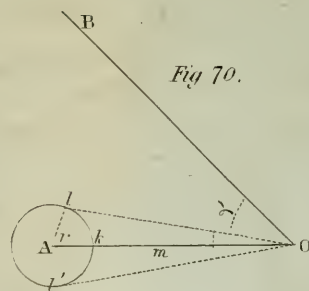


Fig. 70.

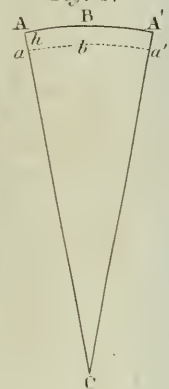


Fig. 77.

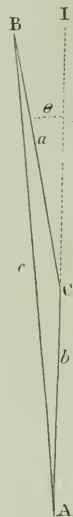


Fig. 61.

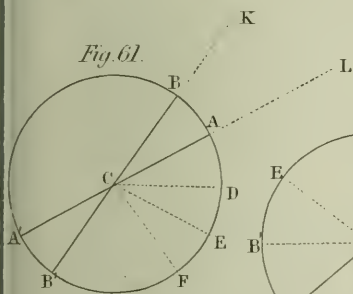


Fig. 62.

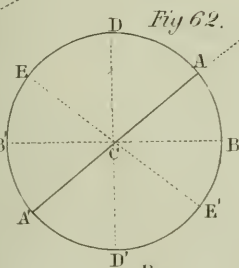


Fig. 63.

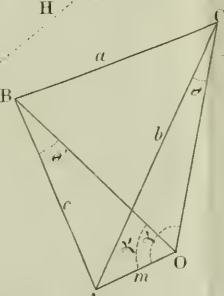


Fig. 56.

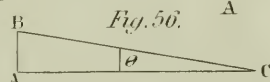


Fig. 67.

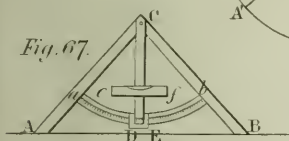


Fig. 68.



Fig. 64.

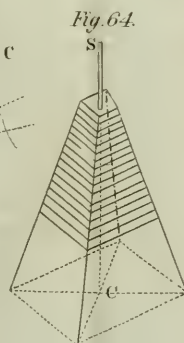
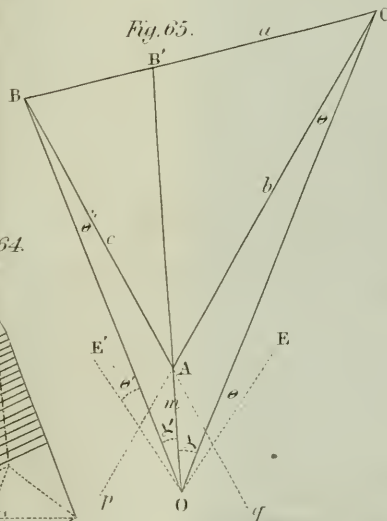


Fig. 65.





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The repeating circle is made of brass with steel screws, and in order that the divisions of the limb and the verniers should be very clean and neat, they are made upon a circle of gold or platinum embedded in the brass. For the purpose of reading the graduation with facility, a magnifying glass is placed at each vernier, and the divisions are protected from the reflected light by ground glass.

103. The telescopes are formed of a cylindrical tube with a glass at each end. The *object* glass, or that towards the object, should be convex and achromatic; that is, formed of two glasses joined together; the density of the interior one should be increased by oxide of lead to prevent the image being colored by foreign tints. The object glass should be as large as is convenient to receive as many rays from the object as possible. It unites these rays at a point in the axis of the tube near the other extremity, called the focus, and forms there a well defined image of the object. At this end the eye-glass is placed, near to which the eye is applied. The eye-glass is very convex, and serves to magnify the image which the object-glass makes at the focus. This focus should be common to both glasses, and very near the eye-glass, which is smaller and more convex.

The eye-glass is fitted to a small tube which can be pushed in or out for a short distance, depending upon the vision of the observer, until a clear well defined image of the object is perceived.

The interior of the telescope is furnished with diaphragms opened in the centre, to exclude the scattering rays of light, which destroy the distinctness of the image. Their oblique direction, producing the aberration of sphericity, causes them to be projected at different foci. At the focus of the object-glass is a diaphragm with an aperture, carrying threads of silk or cobweb crossed at right angles. As these threads should be exactly at the focus of the object-glass, and as the position of this focus changes a little, according as the object is nearer or farther removed, the threads should have a motion along the tube. This condition is essential: for if the threads are not exactly at the focus of the object-glass, they will not appear stationary with regard to the image when the eye is moved a little up or down. This is called the *parallax of the threads*. When this defect exists, there is no certainty that the telescope is directed on the object. However, when the object is very far off, a greater or less distance does not sensibly change the focus of the object, and the threads once properly placed do not require to be changed while observing on distant objects.

It is almost useless to say that when the position of the threads is changed, that of the eye-glass must be changed also, so that the image and the threads may both be seen with distinctness. The object-glass remains always stationary. Thus we commence by bringing the cross

hairs to the focus of the object-glass by successive trials, examining each time to see if there is any parallax of the threads, which is done by observing whether the relative positions of the threads and the image appear to change when the eye is moved up and down before the eye-glass. When there is no change there is no parallax, and the tube carrying the eye-glass is moved until the image and the threads are seen distinctly.

These telescopes reverse images, but no inconvenience results from it. Their optical axis should be exactly parallel to the limb.

104. The *spirit-level* is formed of a glass tube containing alcohol, hermetically sealed at the ends. The tube is not quite filled with the liquid, and the space left is called the bubble. Alcohol is used because it does not freeze and break the glass. Care must be taken to give the interior of one of the sides of the tube a circular form; without which the slightest motion will make the bubble pass from one end of the tube to the other without being able to make it rest in the middle. This is done by the friction of sand and emery. For protection, the glass is encased in a brass tube opened on the upper side. Equal divisions traced on the glass and numbered, serve as marks to show if the bubble is in the middle of the tube, for the length of this bubble diminishes by heat which expands the fluid, and contracts by cold, in a greater proportion than the glass. The maker adjusts the tube in its box, so that the bubble will be in the middle when the axis of the tube, or the part of the instrument to which it is attached, is horizontal.

These spirit-levels properly adjusted and placed, serve to test the perpendicular position of the column of the repeating circle, the horizontal position of the plate, and the vertical position of the limb. The manner of adjusting and using them will readily occur to the reader. The art of constructing the glass tube has been brought to such perfection that the inclination of the plane can be calculated, corresponding to the motion of the bubble along the tube of 1. 2. 3. . . millimetres [0.03937, &c. inches], so that it becomes in fact a *slope level*, by which the inclinations of planes can be determined in seconds.

[TO BE CONTINUED.]

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*Notes on Belgium.* By CAPTAIN G. W. HUGHES, *United States Topographical Engineer.* Addressed to FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

CONTINUED FROM PAGE 83.

After having seen every thing worthy of attention at Seraigne we left in the diligence for Namur. The valley of the Meuse has been



often compared, but the English think without reason, to the picturesque scenery of the Wye. To me it seemed even more lovely than that beautiful region. The valley of the Meuse is narrow but cultivated like a garden to the hill tops. When the slopes are too steep to retain the soil they are divided by stone walls into several terraces, and where the exposure is favorable the vine is grown. It does not, however, produce good wine, the best of it not being much superior to the *vin ordinaire*.

"Stern visaged war" has indelibly impressed his rugged features on this lovely vale. The villages, chateaus, churches, roads, walls and bridges, all seem to have been constructed for purposes of defence—every house is a fortress and every yard is an advanced work. Each beetling cliff is crowned, and the whole country appears clad in complete panoply of war. At Huy (pronounced *we*) the road crosses to the right bank of the river over an ancient stone bridge, and passes directly under the walls of an old cathedral, and the citadel which commands the Meuse above and below. It was repaired and enlarged by the English in 1816, and is regarded as one of the strongest works in this land of fortresses. The rock on which it stands is literally covered with the vine. Near Huy, the old sandstone first makes its appearance, overlaying the transition limestone, (which abounds with caverns.) From Huy to Namur the valley becomes very narrow, and the naked and jutting rocks present an imperfectly columnar appearance, having been much disturbed, and at a distance, somewhat resemble the palisades of the North River.

Feb. 17th. Went to-day to examine the celebrated Citadel of Namur, situated on a narrow rock at the confluence of the Sambre with the Meuse. This is a most wonderful work, and has been called the Gibraltar of Belgium. Wall after wall, rampart after rampart, fort after fort, surrounded with wide and deep moats (scarped and counter-scarped, and broken up with traverses,) and all connected with covert ways, bomb proof and loop-holed, and subterranean galleries, rise from the level of the rivers to the height of nearly 600 feet, on which stands the citadel, with its faces, flanks and curtains completely casemated. Its trace is irregular, but conformable to the contour of the ground, or rather rock, on which it is built, and with which it is incorporated. On the very highest part of the bridge is an advanced work, designed by the Duke of Wellington, and executed at the expense of the British government. This advanced work is built on a deposit of iron ore and imperfect coal, which is not permitted to be worked.

It strikes me that this fortress, like every other similar work in this part of the world, is placed *too high* for its principal design, which was the defence of the valleys of the Sambre and Meuse; but as it regards

its own defence, I should think it as nearly impregnable as human skill can render any naturally strong military position, and that it could not be reduced except by a long continued blockade. Its casemates are seven feet thick at the crown of the arches, and it is surrounded by galleries and mines, while an abundant supply of water for a numerous garrison, rises within its walls. The bridges across the river are both fortified, and the city is a walled town.

It must not be forgotten by the traveler, that here "Uncle Toby" distinguished himself at the Forte St. Nicholas, and it was here "our army swore so terribly," an accomplishment which seems to have been legitimately handed down in the military line to the present day.

Namur is celebrated for its cutlery, and has been called the Sheffield of Belgium. I visited one of the largest cutlery establishments in this city, and was highly gratified with what I saw. I remained long enough to see every process from the forging of the knives to the finishing and packing them. The *tempering* of pen knives, scissors and razors is accomplished by heating them to a certain degree, obvious only to an experienced person, and then dipping them in cold water. Lancets are tempered in cold tallow, and table knives in oil. This imparts more elasticity to the metal than it receives from the other processes.

Belgium abounds with coal and iron mines, marble quarries and building materials of various kinds, and the working of these minerals occupies a high rank among the great interests of the kingdom.

The mining territory of Belgium may be regarded as divided into three districts. The first includes Hainaut and consists of 155 mines, underlaying 256,000 English acres. The second is situate in the Provinces of Namur and Luxembourg, and contains 59 mines, underlying 75,000 acres, and the third embraces the Provinces of Liège and Limbourg, has 138 mines, under 80,000 acres: making in all 352 mines, underlying 411,787 acres, or 66 square leagues of 5,000 metres.

Of the mineral riches, coal (*houille*\*) is regarded as the most important, the more especially as the country, excepting the mountainous districts of Ardennes, is almost destitute of any other species of combustible, and it not only supplies nearly the whole of Belgium with fuel, but a large quantity is annually exported to France from the Southern Provinces, Hainaut alone producing more coal (*charbon de terre*) than the whole of France.† The four central collieries of Mons, Morimont and Liège yield annually 3,200,000 tons (of 1,000 Kilo-

\* This term is, I think Walloon. The Walloon dialect is very similar to the ancient, and now very nearly obsolete, French language.

† In France 198 mines are worked, employing 17,500 miners, and yielding 60,000,000 of bushels of coal, or about 2,000,000 of tons (of 1,000 Killogrammes) valued at \$3,600,000.

grammes—the kilogrammes being equal to 2.20548 lbs. avoirdupois). In 1836, 456 pits were worked for coal in 250 mines, and gave employment for 31,196 workmen, producing 96,000,000 of English bushels, valued at more than \$6,000,000. The price per ton at the pit's mouth was in 1837 at Charleroi from \$3.75 to \$3.50, and at Mons, from \$2.50 to \$2.75, and the prices at present are very nearly the same on an average. The cost of mining a ton of coal at Liege, is but little less than \$2.00. The State owns a colliery called Kerkroade, in Limburg, the rents of which per annum amount to about \$50,000.

In Flanders, Luxemburg, and some other localities, turf is used for fuel, and at Antwerp, Bruges and Ostend, English coals are consumed, as they are imported free of duty.

The following analyses of Belgian coals have been kindly furnished me by the Director in Chief of Mines, Mr. Canchy. A mean of several of the best coals gives the following results, viz:

|      | Spec. gr. | carbon. | hydrogen. | oxygen. | azote. | cinders. | Remarks.                                                                |
|------|-----------|---------|-----------|---------|--------|----------|-------------------------------------------------------------------------|
| 1st. | 1.276     | 84.67   | 5.29      | 7.00    | 0.94   | 2.10     | These are called <i>fat</i> coals, 'le houille grasse à longue flamme.' |
| 2nd. | 1.292     | 83.87   | 5.44      | 7.00    | 0.03   | 3.68     |                                                                         |

He says that no Belgian coals are employed in their natural state for the reduction of iron ores.

I am indebted to Major Frederickx, of the Royal Foundry, for the following analyses of five specimens of coal from the left bank of the Meuse, in the Province of Liege, by C. Davreux.

Major Frederickx observes that the specimens Nos. 1 and 2 are the best combustibles of Liege, and possess great calorific powers, and are generally employed in the reverberatory furnaces. Nos. 3, 4 and 5 are inferior in quality, and are used for ordinary smith's work, and for generating steam.

| Specimens,        | 1     | 2     | 3     | 4     | 5     |
|-------------------|-------|-------|-------|-------|-------|
| Carbon,           | 0.783 | 0.760 | 0.699 | 0.726 | 0.685 |
| Ashes,            | 0.039 | 0.044 | 0.067 | 0.032 | 0.103 |
| Volatile matters, | 0.178 | 0.196 | 0.234 | 0.242 | 0.212 |
|                   | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

1 and 2 coal from the mine of Marair of Ste. Marguerite.

3 " 4 " " " " Olisson au val Benoit.

5 " " " " " Cerisier a la Haye a St. Gilles.



*Analysis of Mineral Coals from the district of Mons, by Berthier.*

## FAT COALS.

|                                                     | 1     | 2     | 3     | 4     |
|-----------------------------------------------------|-------|-------|-------|-------|
| Carbon,                                             | 0.715 | 0.653 | 0.585 | 0.510 |
| Ashes,                                              | 0.052 | 0.017 | 0.030 | 0.050 |
| Volatile matter,                                    | 0.233 | 0.830 | 0.385 | 0.040 |
|                                                     |       | 1.000 | 1.000 | 1.000 |
| * Lead with litharge,                               | 1.000 | 29.0  | 28.1  | 27.4  |
| Carbon equivalent to<br>the volatile matter. }<br>} |       | 0.22  | 0.24  | 0.30  |

\* "Plomb avec la litharge."

No. 1. Coal from the Canton of Dour. Fragile, of a homogeneous blackish colour without being earthy. Its density is 1.27, and it yields from 0.65 to 0.68 per cent. of excellent coke.

No. 2. From the *Vein of Bouleau—Fontaine-Madame*, near Mons. Its density is from 1.260 to 1.287; it yields 0.55 per cent. of "beautiful coke."

No. 3. From the Bed of Grand-Gaillet.

No. 4. From the Gade Vein. The coke of this coal swells very much, (tres boursoufflé) and is light and porous. The coal is admirably adapted to the generation of gas.

*Composition of the dry, or anthracite coals of Mons.*

|                  |   |   |   |   |             |
|------------------|---|---|---|---|-------------|
| Carbon,          | - | - | - | - | 0.850       |
| Ashes,           | - | - | - | - | 0.023       |
| Volatile matter, | - | - | - | - | 0.127       |
|                  |   |   |   |   | <hr/> 1.000 |

Mr. Dumont says, "the combustibles employed for the reduction of metallic ores, are coke and charcoal. In Ardennes they use carbonized wood, (le bois torréfié.)

No copper is reduced in Belgium, but a great deal of brass or yellow copper ("cuivre jaune") is manufactured, and also of bronze; but it is difficult to ascertain the precise amount of the annual production.

The following coals from Liege are by M. Delvaux of the School of Mines:

No. 1. A slaty coal, easily broken and of splintery fracture. It is from the colliery of "l'Arbre St. Michel," commune of *Harion*, *Hoze-mont*, and was taken from the "Dure veine," or hard vein. Its coke is greyish and brilliant; its density 1.365, yields 91.0 of coke; its calo-

rific power 7861.4; the equivalent of carbon to volatile matter 0.18629.

*Composition.*

| Carbon. | Ashes. | Volatile matter. |
|---------|--------|------------------|
| 81.9    | 9.10   | 9.00 = 10.000    |

No. 2. Fragile, schistose, lustre resinous, from the colliery of Bal-daz-la-lore, commune of *Chokier*, and bed *Petite Hareng*. Density 1.286; coke very much swelled, (tres boursoufflé), of which it yields 83.67.

*Composition.*

| Carbon. | Ashes. | Volatile matter. |
|---------|--------|------------------|
| 71.68   | 11.96  | 16.36 = 100.00.  |

No. 3. Schistose, lustre resinous, from the colliery of *Bonnier*, bed *Moset*. Its density 1.318. Coke pulverulent, of which it yields 92.00.

*Composition.*

| Carbon. | Ashes. | Volatile matter. |
|---------|--------|------------------|
| 91.388  | 0.612  | 8.00 = 100.00.   |

I have been at some trouble to obtain these results, in the hope that they may be rendered useful, as a means of comparison between our ores at home and those of foreign mineral productions.

Iron mines are very common in this country. The ores closely resemble in organic composition, those of France; they contain nearly the same elements, and produce iron of almost the like quality, but the French iron brings generally the highest price in market, which may be owing, in a great degree, to its being reduced with charcoal.

There is perhaps no country in Europe of the same extent, that contains more iron ores and a greater variety of them, than that between the Sambre and the Meuse. It is this district which furnishes the minerals for the furnaces of the Sambre, and partly for those of the Meuse and Liege. Besides this district there are a great number of mines worked in the Provinces of Liege, Limburg and Luxemburg. In 1836, the blast furnaces consumed 456,000 tons of worked iron ore, being about one half of the unworked ore as it is extracted from the earth. The ore is worked to free it from the earthy matter, which adheres to it. The consumption has greatly increased since 1836, but I have seen no authentic returns of the present amount.

I am indebted to the superintendent of the Royal Foundry for the following analysis of iron ores employed at the foundry. He says, "I regret not having been able to obtain analyses of all the iron ores employed in the reduction of the iron used for the fabrication of cannon at the Royal Foundry; but I send you the results of four specimens of

the best ores, which produce a very strong iron. The other ores do not differ materially in composition from them."

*Analysis of four specimens of hydrated oxide of Iron from Hotbomont, near de Theux, Liège, by C. Davreux.*

| Specimens,        | 1     | 2       | 3     | 4     |
|-------------------|-------|---------|-------|-------|
| Peroxide of iron, | 0.839 | 0.804   | 0.732 | 0.591 |
| “ “ manganese,    | 0.023 | 0.036   | 0.099 | 0.115 |
| Silex,            | 0.031 | 0.039   | 0.035 | 0.103 |
| Alumine,          | 0.000 | 0.008   | 0.012 | 0.050 |
| Lime,             | 0.000 | a trace | 0.003 | 0.007 |
| Water,            | 0.107 | 0.113   | 0.119 | 0.134 |
|                   | 1.000 | 1.000   | 1.000 | 1.000 |

Mr. Cauchy, the Chief Director of Mines, says that there are two very distinct species, or classes, of iron ores. The one a *red oxide*, extremely rich, but yielding a brittle iron, owing to the presence of phosphoric acid—the other a yellow and brown hydrated ore, yielding not more than 30 or 40 per cent. of metal, in consequence of its being very argillaceous, but the iron is of an excellent character and very strong.

I am indebted to Professor Dumont, of Liege, (at the instance of M. Juetelet, perpetual Secretary of the Royal Academy of Brussels,) for the following analysis of iron ores.

*Analysis of the Limonite, (Hydrated Oxide of Iron,) from the Angleur Mine, near Seraigne. By Professor Le Soinree.*

This limonite is zinciferous.

|                                          |        |
|------------------------------------------|--------|
| 10 grammes* of crude ore = calcined ore, | 8.30   |
| We add for a flux, Argile,               | 1.00   |
| 0.8 carbonate of lime = quick lime,      | 0.45   |
|                                          | <hr/>  |
| Total of fixed matter,                   | 9.75   |
| We obtained of pig iron, 4.52,           |        |
| of scoria, 1.63,                         | = 6.15 |
|                                          | <hr/>  |
| Loss in oxygen and oxide of zinc,        | 3.60   |

The solvent, or flux, (le fondant,) was 1.45. There remain for the vitreous matter of the ore, 0.18, and the zinc was entirely volatilized. The iron was gray, and of a good quality.

\* The gramme is = 15.4 grains, or the one thousandth of a kilogramme.



*Analysis of the same Ore.\* By Mons. Berthier.*

|                            |       |
|----------------------------|-------|
| Oxide of iron, - - -       | 0.626 |
| Water and carbonic acid, - | 0.170 |
| Silex, - - -               | 0.032 |
| Oxide of zinc, - - -       | 0.172 |
|                            | <hr/> |
|                            | 1.000 |

*Analysis of the Argillaceous Carbonate of Iron of the Coal Measures (fer Carbonatè Argileux de Houilleries,) of Dour, (Mons.) By Berthier.*

|                                                    |       |
|----------------------------------------------------|-------|
| 10 grammes of crude ore = of calcined ore,         | 7.60  |
| Added as flux, 3.60 of lime stone = of quick lime, | 2.03  |
|                                                    | <hr/> |
| Total,                                             | 9.63  |

|                 |                    |   |       |
|-----------------|--------------------|---|-------|
| And we obtained | of pig iron, 2.37, |   |       |
|                 | of scoria, 6.20,   | = | 8.57  |
|                 |                    |   | <hr/> |

|                                 |                          |       |
|---------------------------------|--------------------------|-------|
|                                 | Loss in volatile matter, | 1.06  |
| Flux, - - -                     | - - -                    | 2.03  |
| Vitreous matter of the ore, - - | - -                      | 4.17  |
| Insoluble, " - - -              | - - -                    | 3.60  |
|                                 |                          | <hr/> |
| Soluble, " - - -                | - - -                    | 0.57  |

The metal was grayish, and good for rolled iron. The slag was vitreous, transparent, and of a deep gray colour.

*Analysis of the Limonite of Bayon, (Liege,) made at the Laboratory of the School of Mines. By M. Delvaux.*

This mineral is of a dark brown colour, hard, and compact. It loses, by calcination, 0.19 of water and carbonic acid, and when treated with hydro-chloric acid, leaves a residuum of silex = 0.032. Weak nitric acid dissolves 0.181 of carbonate of lime, and 0.024 of carbonate of zinc.

|                                            |       |
|--------------------------------------------|-------|
| 10 grammes of crude ore = of calcined ore, | 8.10  |
| There was added, as a flux, Silex,         | 1.55  |
| Clay,                                      | 1.00  |
| Lime stone, 2.50 = of lime,                | 1.41  |
|                                            | <hr/> |
| Total of fixed matter,                     | 12.06 |

\* It was from this ore the best gun metal was formerly obtained for the Royal Cannon Foundry; but it is all used, at present, at Seraigne.

|                     |        |                 |   |       |
|---------------------|--------|-----------------|---|-------|
| Amount forward,     |        |                 |   | 12.06 |
| There was obtained, | metal, | 3.65 (of iron,) |   |       |
|                     | slag,  | 5.32            | = | 8.97  |
|                     | Loss,  |                 |   | 3.09  |
| The flux added,     |        | 3.96            |   |       |
| Insoluble matter,   |        | 0.32            |   |       |
| Soluble “           |        | 1.04            |   |       |

There remained, of the vitreous matter of the ore, 1.36.

The metal obtained was gray, and malleable.

*Analysis of a Specimen of Pig Iron, (fonte,) from Charleroi. By Berthier.*

This iron was prepared with coke, is of a *deep*, or *dark* gray colour, without being black; is very soft, and makes the best castings for machinery of any iron of the continent.

|         |   |   |   |   |       |
|---------|---|---|---|---|-------|
| Carbon, | - | - | - | - | 0.023 |
| Silex,  | - | - | - | - | 0.035 |
| Iron,   | - | - | - | - | 0.942 |
|         |   |   |   |   | 1.000 |

*Ores of Zinc. By Berthier.*

Anhydrous carbonate of zinc, from Ampsin, near Huy.

|                       |         |                          |
|-----------------------|---------|--------------------------|
| Oxide of zinc,        | 0.574   | 0.890 carbonate of zinc, |
| “ iron,               | 0.040   | 0.065 “ “ iron,          |
| “ manganese,          | a trace | 0.042 gangue,            |
| Water and carb. acid, | 0.341   |                          |
| Earthy gangue,        | 0.042   | 0.997                    |
| Total,                | 0.997   |                          |

Calamine from “Old Mountain,” between Liege and Aix la Chapelle.

|                    | No. 1. | No. 2. |
|--------------------|--------|--------|
| Oxide of zinc,     | 0.632  | 0.054  |
| Silex, - -         | 0.256  | 0.020  |
| Water, - -         | 0.010  | 0.006  |
| Carbonate of zinc, |        | 0.890  |
| Oxide of iron, -   | 0.048  | 0.030  |
| Alumina, -         | 0.034  |        |
|                    | 0.980  | 1.000  |

No. 1. Anhydrous calamine.

No. 2. The ordinary yellow amorphous ore of zinc. It is a mixture of the anhydrous carbonates, and the hydrated silicates of zinc. This mineral, when calcined and decomposed, is found to consist of the following constituents.

|                              |       |
|------------------------------|-------|
| Oxide of iron, - - - -       | 0.083 |
| “ zinc, - - - -              | 0.647 |
| Carbonic acid and water, - - | 0.072 |
| Alumina and silex, - - - -   | 0.195 |
|                              | <hr/> |
|                              | 0.997 |

The extraordinary abundance of the mineral resources of Belgium, including fuel, has given rise to the establishment of numerous works for the manufactory of castings, of rolled iron, of steel, of sheet iron, of copper, and of tin. This branch of industry may be considered as divided into three principal groups. *First*, the River group, (that of the Meuse, from its entrance into Belgium to the limits of the Provinces of Namur and Liege.) *Second*, the group between the Sambre and Meuse, (including the furnace of Couvin,) and *third*, the group of Charleroi, (to which are attached the furnaces of Clobecq, near Tubin.) Beside these groups, we must observe that on the Floyoux, on the Ourthe, and on the tributaries to this latter river, there are a large number of blast furnaces, forges, rolling mills, and foundries. In 1837, there were in Belgium, twenty-three blast furnaces, worked with coke, and sixty-six with charcoal, in constant use.\* There are at present not less than forty-five coke furnaces in operation, and the number is rapidly increasing. A company has recently erected, on the plains of Sclessin, six enormous coke furnaces, in a single stack, of dimensions heretofore unknown on the continent.

It is estimated that the furnaces of this kingdom produce nearly 200,000 tons (of 1000 kilogrammes,) of iron, annually; the French furnaces yielding about 300,000 tons, and the English considerably more than 600,000.

From 1830 to 1836, the mean price of rolled iron was, for the best quality, about \$80 per ton, and for the second quality, \$60 per ton, the highest price having been paid for the first quality, \$90, and the lowest, \$75. There is, at present, quite a depression in this branch of production.

Copper ore is found principally in the provinces of Hainaut and

\* In France, there are 508 blast furnaces, of which twenty-eight only are worked with coke. It has been ascertained that coke furnaces yield from three to five times more metal than the charcoal furnaces.



Liege; lead in those of Liege, Namur, and Luxemburg, in which is situated the Longilly mine, the most important locality in the country. Zinc is worked at Namur and Hainaut; manganese in Liege; pyrites, calamine, sulphur, and alum, in Namur and Liege.

TO BE CONTINUED.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the cost of Embankments of Earth, when made with Carts.*

By ELLWOOD MORRIS, *Civil Engineer.*

Early in his professional career, the writer had frequent occasion to deplore the want of accurate knowledge, regarding *the cost per cubic yard* of embankments of earth; having sought through books in vain for correct information upon this point, he endeavoured to supply the defect by application to the experience of elder practitioners, but soon found that even the most experienced Engineers, whom he had the opportunity of consulting, possessed only vague and uncertain information upon this subject; they decided the value of embankment by judgment alone—hence they were frequently mistaken—and none with whom he then conferred, seemed to be acquainted with any rule for the general determination of this question from easily acquired data; this apparent deficiency amongst professional men, concerning a matter of such importance as the value of embankment, entering so largely as it does into the construction of public works, attracted the fixed attention of the writer, and determined him to commence, and upon every convenient occasion to prosecute, a series of experiments with different soils and lengths of hauling, until sufficient data was acquired to enable him to effect a practical solution of *the problem of the value per cubic yard of embankments of earth of any given average haul.*

The observations necessary for the acquisition of suitable data, were made in the formation of embankments of different soils, in different situations, in various stages of weather, and with mean lengths of haul ranging from 100 to 1800 feet; these preliminaries were completed some years ago, formulæ based upon these were drawn out, and now after having satisfactorily tested their accuracy by actual application, to the ascertained cost of embankments of different soils and average hauling, amounting in the aggregate to *more than one hundred and fifty thousand cubic yards*; the writer conceives that they have been verified by practice, upon a scale sufficiently large to warrant him in offering them to the public, with the assurance that *these formulæ may safely be relied upon in practice.*

Owing to the great diversity observable in the consistency of the natural soils, whence embankments are usually formed, something

must of course be left to the judgment of the Engineer; but it is fortunately practicable, both to rescue from the dominion of conjecture, the chief items of cost, and also to confine the chances of errors within very narrow limits—such is the inherent character of the question solved by our formulæ—how successfully, will appear in the comparisons we shall hereafter adduce, between the carefully ascertained cost of several considerable embankments, and the value per cubic yard, which under the same circumstances, would result by computation from the formulæ.

### *Vehicle and pace of Transportation.*

Unlike the course usually pursued *abroad*, where embankments are generally made by cars, carried out upon a temporary railway, and dumped in a single breast of the full height of the bank; *in this country* embankments are almost invariably *formed in layers, and the materials hauled on in carts drawn by a single horse.*

A one horse cart is assumed to be the vehicle of transportation to the embankments of which our formulæ will determine the cost, and it is *to carted embankments alone* that the present remarks and computations are designed to apply.

A numerous series of experiments repeatedly verified, indicate that the average pace of a horse in carting embankment, is at the rate of *one hundred feet of trip or 200 feet lineal per minute*; by *trip* we design to include *both* going out and coming back, the outward pace with the load being a little slower, and the inward rather faster, so as to establish as *a mean result* the progress stated above.

### *Classes of Earth, and days' work of Men loading each.*

For practical uses it will be sufficient to divide common earth into *three classes*, varying in their consistency and somewhat in their density, though such a classification must necessarily be arbitrary, as it is utterly impossible so to classify earthy materials, as to meet and cover *exactly* every practicable case.

1st class.—*Gravelly Earth.*—This includes all such materials as gravel, or gravel and clay mixed, and in fact all the heaviest and firmest earths.

Satisfactory experiments have established the fact, that of the material we call *gravelly earth*, a medium laborer will load into a cart in ten working hours, *ten cubic yards measured in bank.*

2nd class.—*Loam.*—This includes those earths so generally found, which consist mainly of sand and clay mixed.

Of this material, experiments indicate, that a medium laborer will, within ten hours work, load into a cart, *twelve cubic yards measured in bank.*

3rd class.—*Sandy Earth*.—This includes the marly earths, along with those in which sand predominates; this material is usually light, loose, and easily handled.

Experiments have proved, that of this species of material a medium laborer in ten hours of work, will load into a cart, *fourteen cubic yards measured in bank*.

To load, of the several classes of earth respectively, material equivalent to 10, 12, and 14 cubic yards *measured in bank*, requires the lifting of about  $\frac{1}{3}$  more if *measured in excavation*, and this is owing to the well known *compression of earth when placed in bank*, a subject we do not propose to discuss in this connexion, as it does not seem indispensably necessary to the present purpose.

#### *Species of haul, and cartload in each.*

As we have made a practical division of earthy materials, into three species, so also will we classify the hauling in its application, to average weather, and such embankment roads as are commonly used upon well managed works, and in deciding to which class any particular case of hauling belongs, *the general features of the road and the probable draft thereon*, must be carefully considered, as no exact and universal rule can be established.

1. *Descending hauling*.—In this species carts usually carry  $\frac{1}{3}$  of a cubic yard *measured in bank*.

2. *Level hauling*.—In this species carts generally average  $\frac{1.0}{3.5}$  of a cubic yard *measured in bank*.

3. *Ascending hauling*.—In this species carts generally carry  $\frac{1}{4}$  of a cubic yard *measured in bank*.

#### *Loosening the material.*

Shovels with short handles are usually employed in loading earth for embankments, but before the shovellers can operate, it is generally necessary to *loosen the material* either by *the pick or plough*, though the lighter soils of the third class (*sandy earth*) may frequently be spaded at once into carts.

*Gravelly earth*, and the stiffer kinds of clay generally require to be loosened by *the pick*. *Loam* can almost always be *ploughed* by a good team, and *sandy earth*, when it cannot be *spaded*, will always yield to *the plough*.

The expense of *loosening* or preparing the earth to be loaded into carts by the shovellers, will seldom be less than *one*, and not often more than *eight cents* per cubic yard, but this is one of those subordinate items which is variable in its nature, and must necessarily be left to be fixed by the judgment of the Engineer, upon view of the



material, the cost of forming which into an embankment of *a given mean haul*, he desires to know.

In *loam* the writer found, by a number of experiments, that a three horse plough would loosen for the shovellers, from 250 to 800 cubic yards per day, which, when the plough and drivers cost \$5 per day, would cause the value of *loosening* to vary from two cents to six mills per yard; hence it is evident that an error in estimating the value of loosening, will not very essentially affect the results produced by our formulæ, because this item is but *a small part of the whole cost* of a cubic yard of bank.

### Notation and Data.

*Constant quantities* ascertained by carefully verified experiments.

1. Number of feet of *trip* traveled by each cart per minute = 100 feet, or 200 feet lineal actually moved over.

2. Number of cubic yards of earth *measured in bank* which can be loaded per day of ten hours working time, by a medium laborer, viz:

Of *gravelly earth* = 10 cubic yards.

Of *loam* " = 12 " "

Of *sandy* " = 14 " "

3. *Time lost* in loading, dumping, waiting to load, and all other lost time, per load = 4 minutes.

4. Number of cart loads to the cubic yard of bank.

In *descending hauling* = 3

In *level hauling* =  $3\frac{1}{2}$

In *ascending hauling* = 4

5. Cost of trimming and bossing, at a general mean ascertained to be about *one cent* per cubic yard.

*Variable quantities*, some of which depend upon the prices of labor, and others upon a correct judgment of the circumstances of the case.

*a* = *average haul* of the embankment, in stations of 100 feet each; thus calling 1245 feet  $12\frac{45}{100}$  stations.

*b* = *number of hours actually wrought* per day, which will average through the year about ten hours working time per day.

*c* = *daily wages of one laborer*, including all allowances, in cents.

*d* = *daily wages of one cart*, including driver and all other expenses, in cents.

*e* = *cost of loosening the material* in cents per cubic yard.

The above or the variable quantities, can generally be determined in every case with sufficient accuracy.

*Unknown quantities*, which will be determined by the solution of the several formulæ.

$x$  = number of cubic yards measured in bank, which can be hauled by each cart per day, to the distance of the given average haul, and there deposited.

$y$  = the cost in cents of one cubic yard of embankment of the given average haul; clear of all profit to the contractor or person doing the work.

*Formulæ, for finding  $x$ , the load in cubic yards hauled per day by each cart.*

Representing the number of cartloads to the yard by  $f$ , the general formulæ will be,

$$\frac{\left( \frac{60}{\frac{a}{100} + 4} \right) b}{f} = x.$$

Now substituting successively in the general formulæ instead of  $f$ , its numeral values in the several species of hauling (3,  $3\frac{1}{2}$ , 4,) and then operating upon the resulting formulæ, according to the laws which govern the mutations of algebraic fractions, we derive the following equations:

For *Descending hauling*,  $\frac{20 b}{a + 4} = x. \quad . \quad . \quad (I.)$

For *Level hauling*,  $\frac{17\frac{1}{2} b}{a + 4} = x. \quad . \quad . \quad (II.)$

For *Ascending hauling*,  $\frac{15 b}{a + 4} = x. \quad . \quad . \quad (III.)$

*Formulæ for finding  $y$ , the net cost per cubic yard of embankment of earth.*

Denoting the number of cubic yards of each class of earth, which can be loaded by a medium laborer in a day of ten hours working time, as heretofore stated, by the symbol  $g$ , and putting one cent, for the cost of trimming and bossing per cubic yard; the general formula will be,

$$\frac{c}{g} + \frac{d}{x} + e + 1 = y.$$

On substituting successively for  $g$  its numeral values (10, 12, 14,) in the several different classes of earth, we have,

1st class—*Gravelly earth*,  $\frac{c}{10} + \frac{d}{x} + e + 1 = y, \quad . \quad (IV.)$

2nd class—*Loam*,  $\frac{c}{12} + \frac{d}{x} + e + 1 = y, \quad . \quad (V.)$

3rd class—*Sandy earth*,  $\frac{c}{14} + \frac{d}{x} + e + 1 = y, \quad . \quad (VI.)$

*Formulae, for finding the cost per cubic yard of Embankments of Earth, verified by practice.*

The chief part of the cases we are about to cite, as proving the accuracy of our equations of cost, in all which the actual expense of some considerable embankments became known to the writer in a mode that precluded the possibility of mistake, is derived from actual practice upon the Chesapeake and Ohio Canal.

EXAMPLE 1.

*Amount of embankment* = 28,100 cubic yards.

*Material of earth of the second class, loam.*

*Level hauling*, an average of  $6\frac{1}{2}$  stations, or 650 feet, . = *a*

*Loosening by the plough alone,  $1\frac{1}{2}$  cents per cubic yard, . . . = c*

$$\text{Hours wrought per day} = 10 \quad . \quad . \quad . \quad . \quad . \quad . = b$$

*Laborers' wages per day at an average of 106 cents,* . . . = *c*

|                     |   |   |   |            |   |   |            |
|---------------------|---|---|---|------------|---|---|------------|
| <i>Carts' wages</i> | " | " | " | 157 cents, | . | . | = <i>d</i> |
|---------------------|---|---|---|------------|---|---|------------|

*Bossing and trimming* per cubic yard = 1 cent.

*Actual cost* of the 28,100 cubic yards of embankment, clear of  
bossing and trimming = \$5363.

$$\text{Cost per cubic yard} = \frac{\$5363}{28,100} \quad . \quad . \quad . \quad . \quad . = 19 \overset{\text{cents.}}{\underset{1}{}}$$

Add for bossing and trimming, . . . . . = 1

Total cost per cubic yard, . . . . . = 20.10

*Cost by the Formulæ.*

1st. By Formula (II.) to find  $x$ , the load hauled per day.

(II.)  $\frac{17\frac{1}{7}b}{a+4} = x$  substituting for  $a$  and  $b$  their numeral values,

we have  $\frac{17\frac{1}{7} \times 10}{6\frac{1}{2} + 4} = \frac{1,200}{7} = \frac{1,200}{73.5} = 16\frac{3}{10}$  cubic yards =  $x$ .

2nd. By Formula (V.) to find  $y$ , the cost per cubic yard in bank.

(V.)  $\frac{c}{12} + \frac{d}{x} + e + 1 = y$ . Substituting the numeral values of the letters,

we have  $\frac{106}{12} + \frac{157}{16.3} + 1.67 + 1 = 21\frac{1}{10}$  cents =  $y$ , the cost per yard.

*Difference between the real and calculated cost = 1 cent per yard.*

### EXAMPLE 2.

*Amount of Embankment* = 42,140 cubic yards.

*Material of Earth* of the third class; *sandy earth*.



*Level hauling*, an average of 9 stations, or 900 feet, . . . =  $a$   
*Loosening* by plough and spade = 1 cent per cubic yard, . . =  $e$   
*Hours wrought* per day = 10, . . . . . =  $b$   
*Laborers' wages* per day at an average = 110 cents, . . =  $c$   
*Carts' wages* " " " = 160 cents, . . =  $d$   
*Bossing and trimming* = 1 cent per cubic yard.

*Actual cost* of the 42,140 cubic yards clear of bossing and trimming = \$8,775.

|                                                 |                            |
|-------------------------------------------------|----------------------------|
| Cost per cubic yard, = $\frac{\$8,775}{42,140}$ | cents.<br>$20\frac{8}{10}$ |
| Add trimming and bossing, . . . . .             | = 1                        |
|                                                 | = $21\frac{8}{10}$         |

*Cost by the Formulæ.*

1st. By Formula (II.) to find  $x$ , the load hauled per day.

(II.)  $\frac{17\frac{1}{7} b}{a + 4} = x$ . Substituting for  $a$  and  $b$  their numeral values,

we have,  $\frac{17\frac{1}{7} \times 10}{9 + 4} = \frac{1,200}{7} = \frac{1,200}{91} = 13\frac{2}{10}$  cubic yards =  $x$ .

2nd. By Formula (VI.) to find  $y$ , the cost per cubic yard in bank.

(VI.)  $\frac{c}{14} + \frac{d}{x} + e + 1 = y$ . Substituting the numeral values of the letters,

we have,  $\frac{110}{14} + \frac{160}{13\frac{2}{10}} + 1 + 1 = 22$  cents =  $y$ , the cost per yard.

*Difference* between the real and calculated cost =  $\frac{2}{10}$  of a cent per cubic yard.

EXAMPLE 3.

*Amount of Embankment* = 23,500 cubic yards.

*Material of Earth* of the third class; *sandy earth*.

*Ascending hauling*, an average of 6 stations, or 600 feet, . . =  $a$   
*Loosening* by the plough and spade = 1 cent per cubic yard, =  $e$   
*Hours wrought* per day = 10, . . . . . =  $b$   
*Laborers' wages* per day at an average = 120 cents, . . =  $c$   
*Carts' wages* " " " = 165 cents, . . =  $d$   
*Bossing and trimming* = 1 cent per cubic yard.

*Actual cost* of the 23,500 cubic yards of embankment clear of bossing and trimming = \$4,939.







*Difference between the real and calculated cost* =  $\frac{2}{10}$  of a cent per cubic yard.

*Recapitulation of the comparisons between the real and calculated cost per cubic yard of Embankments of Earth containing in the aggregate 151,815 cubic yards.*

| No. of experiments. | Number of cubic yards in the bank. | Average haul in stations of 100 feet each. | Kind of hauling. | Class of the earth. | Actual cost per cubic yard in cents. | Cost calculated by the Formulæ in cents. | Difference per cubic yard in cents. |
|---------------------|------------------------------------|--------------------------------------------|------------------|---------------------|--------------------------------------|------------------------------------------|-------------------------------------|
| 1                   | 28,100                             | 6 $\frac{1}{2}$                            | level            | loam                | 20 $\frac{1}{10}$                    | 21 $\frac{1}{10}$                        | 1                                   |
| 2                   | 42,140                             | 9                                          | level            | sandy earth         | 21 $\frac{8}{10}$                    | 22                                       | $\frac{2}{10}$                      |
| 3                   | 23,500                             | 6                                          | ascending        | sandy earth         | 22                                   | 21 $\frac{6}{10}$                        | $\frac{4}{10}$                      |
| 4                   | 36,000                             | 9 $\frac{2}{10}$                           | level            | sandy earth         | 22 $\frac{6}{10}$                    | 22 $\frac{9}{10}$                        | $\frac{3}{10}$                      |
| 5                   | 22,075                             | 10                                         | level            | loam                | 27 $\frac{9}{10}$                    | 28 $\frac{1}{10}$                        | $\frac{2}{10}$                      |

An examination of the above table shows that the differences between the *real and calculated cost* per cubic yard, of the several quantities which, when aggregated, form the full amount of 151,815 cubic yards of bank, did in no case exceed *one cent per cubic yard*.

Other tests upon smaller individual amounts having verified the embankment equations with equal precision, the writer hazards nothing in expressing his conviction that the formulæ above given, *will, as general rules, be found trustworthy*.

The formulæ apply equally well to every species of hauling in single carts, by making such slight alterations as would be due to the difference, between the specific gravity of common earth and of the other material proposed to be hauled; thus if the equations are properly transformed, the application of the rules to embankment of rock, hauled in one horse carts is both simple and easy.

Here our remarks naturally terminate, and further the mathematical reader need not progress; but although the foregoing equations of cost, are expressed in the simplest algebraic forms, still as there may be some amongst our readers who are not much used to the symbols of algebra; we will, even at the risk of prolixity and repetition, enunciate them in words at length for the benefit of such persons; the Roman

numerals indicate in the several rules those formulæ which are turned into common language.

*To find the load in cubic yards hauled per day by each cart.*

#### I. IN DESCENDING HAULING.

Multiply the number of hours wrought per day by the number 20, then divide the product by the number of stations (of 100 feet each) contained in the average haul, added to the constant number 4, and the quotient will be the number of cubic yards which one cart can haul the given distance in a day.

#### II. IN LEVEL HAULING.

Same as rule I, except that the first multiplier must be  $17\frac{1}{7}$  instead of 20.

#### III. IN ASCENDING HAULING.

Same as rule I, except that the first multiplier must be 15 instead of 20.

Having by one of *the rules* above, found the number of cubic yards which a cart can haul in a day of 10 hours' work, upon the kind of road referred to, then by one of *the rules following*, the cost of the embankment per cubic yard may be found, if the class of the earth whence it is formed be known.

*To find the cost in cents per cubic yard of Embankment of Earth.*

#### IV. BANK FORMED OF GRAVELLY EARTH.

Divide the daily wages in cents of one laborer by the number 10, add the quotient to that of the daily wages of one cart in cents, divided by the number of cubic yards hauled per day per cart, as found by former rules, and to the sum of these two quotients, add successively the estimated cost in cents per yard, of loosening the material, and one cent for bossing and trimming, the sum of all will be the cost of one cubic yard of the embankment.

#### V. BANK FORMED OF LOAM.

Same as rule IV, except that the first divisor must be 12 instead of 10.

#### VI. BANK FORMED OF SANDY EARTH.

Same as rule IV, except that the first divisor must be 14 instead of 10.

Of course in using any of these rules the average length and kind of haul, the wages, &c., must be previously known as in the several examples adduced.

*Philadelphia, July 19th, 1841.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

COLONEL LONG'S *Bridges*.

In a former number of this Journal, (see vol. xxiv, pp. 325 to 333,) are exhibited specifications and drawings explanatory of certain improvements in bridge building, under the designations of the brace bridge, and the suspension bridge, patented by Col. Long, on the 7th of November, 1839. In the present number, we take occasion to lay before our readers additional drawings of the same methods of construction, in one of which is presented a side view of an entire truss-frame of the brace bridge, and in the other a similar view of an entire truss-frame of the suspension bridge. (See the drawings on plate II.)

In the figures relating to both methods, the inferior arch braces, with their appropriate gibs, keys, and other fastenings, are represented, rising from their appropriate bearings at the abutment and pier, and connecting with the lower strings, at points suitable for their reception. In the side view of the brace bridge, the appropriate positions of the side arch braces with their sills at the lower, and plates at the upper strings, are represented by dotted lines. On each side of the truss-frame, a sill may be applied at each abutment and pier, in contact with the lower string, and extending through one or more panels, at the discretion of the builder; and in like manner, a plate may be applied midway of each span, in contact with the upper string, and extending through one, or more, panels, from the centre of the span. From the sills, one, or more, arch braces in each half span, may rise and pass diagonally across one, or more, panels, in a direction towards the centre of the span, being extended far enough to reach the plates, with which, as also with the sills, the brace timbers should be connected by means of appropriate notches, tuscums, &c. The side arch braces, sills, and plates, at their junction, should be connected to the truss-frames by screw bolts, and iron plates or washers, the bolts passing entirely through the truss-frame. Screw bolts, in like manner, should be applied at every intersection of the posts by side arch braces. The fastenings at all other points should consist of tree-nails, which should be inserted in such positions, and with such frequency, as to ensure the requisite action and efficiency in those useful parts of the structure.

The arrangement here contemplated, differs very considerably from that provided for, agreeably to the specifications before cited. Its advantages consist in the greater facility and economy with which the inferior and side arch braces may be applied to a truss-frame, and in the greater frequency with which these useful and important parts of the structure may, with convenience, be applied.

S. H. L.



*Notices of Railways in Germany.*

From the London Railway Magazine.

Although the first railroad in Germany intended for the transportation of passengers and goods, that from Budweis to Lintz, had been undertaken already in 1824, it was not until the last five years that this line of internal communication has been somewhat generally introduced in this part of the European continent. But in this short period a great deal has already been accomplished, and after a few years more, Germany will boast of a railway system by which its principal and important cities will be connected. A description of the different railways already completed, or in course of construction, made from authentic data collected on the spot, will perhaps be of some interest to the readers of the Railway Magazine, not only because England is so much interested in those works, for which it furnishes the iron, machinery, &c., and sometimes even the engineers, but also by making the English traveller acquainted with the means of internal communication of which he can avail himself, on his tours through the continent. In the following series of articles on the above subject the different railways are described in the order they have been examined, and no regard is paid as to which has been first executed.

*The Taunus Railway.—(From Frankfort-on-the-Main to Mentz and the Wiesbaden.)*

This railway derives its name from the Taunus Mountains, along which it extends; it connects the commercial city of Frankfort-on-the-Main, with the steam navigation on the Rhine, the important city and fortress of Mentz, and the much frequented watering place of Wiesbaden, and passes through the territories of the free city of Frankfort, of Hesse Darmstadt and of Nassau. The Company for the construction of this railway was formed in 1836, and the capital of three millions of florins (or £250,000 sterling) subscribed; owing to the high value of the lands in this section of country, and the circumstance of the railway being located through three different territories, great difficulties were experienced in the procuration of the right of way, which, at the same time, has cost the Company an enormous sum. The construction of the railway was commenced in 1837; in September, 1839, the section between Frankfort and Hochst, of five miles, was opened for public use, and in April, 1840, the whole line from Frankfort to Mentz and Wiesbaden.

The principal object of the Taunus railway is the conveyance of passengers between the above mentioned places, and from its favourable position, it will always command a passenger traffic, and may be classed amongst the important and profitable lines of internal improvement in Germany. Frankfort, with a population of 50,000, is the centre of a considerable intercourse; there are constantly from 10 to 20,000 strangers in the city, coming from, and continuing their journey to, every part of the continent. Mentz contains 36,000 inhabitants, besides a garrison of 20,000 men; and the population of Wiesbaden is 12,000. The river Main, on which Frankfort is situated, and which empties itself into the Rhine at Mentz, is not navigable

Entered in the Patent Office  
 May 13<sup>th</sup> 1840  
 Town, Franklin, Institute.

Vol. II. 3<sup>rd</sup> Ser. Pl. II.

Fig. 1.

# COL. LONG'S BRIDGES.

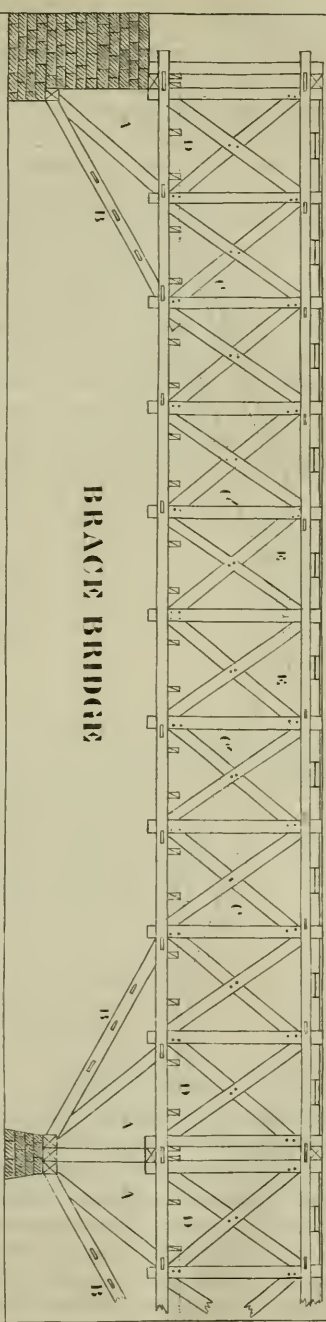
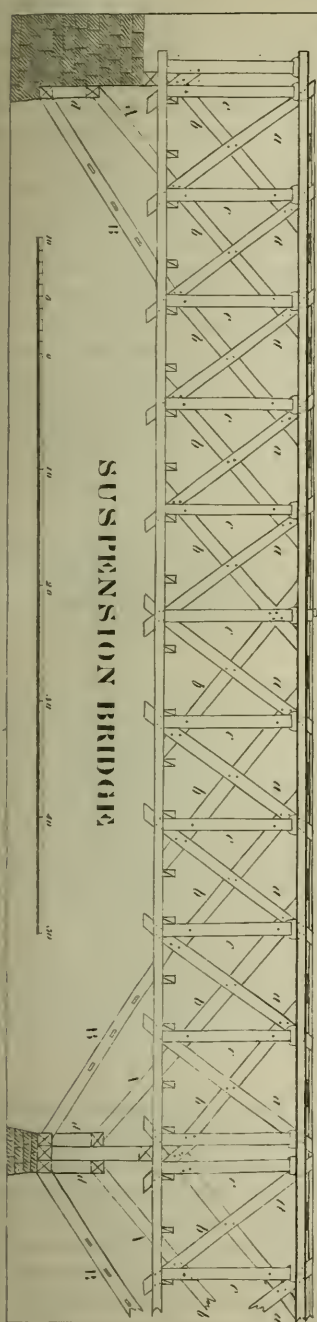
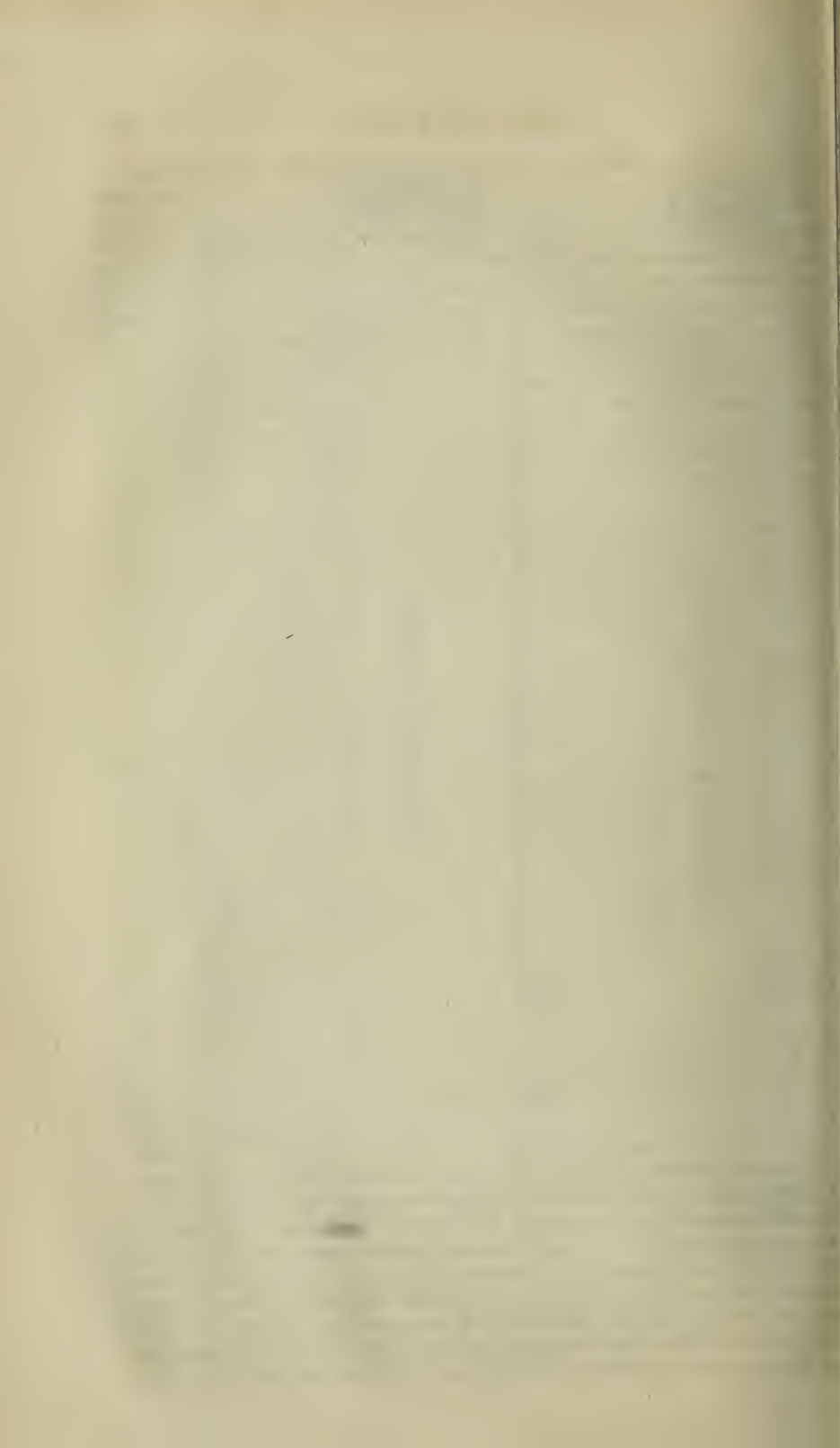


Fig. 2.

# SUSPENSION BRIDGE







for steamboats, owing to the shallowness of its water during summer. At Mentz the steamboats from the upper and lower Rhine meet, and the railway trains run in connexion with them. Still more important and prosperous the Taunus railway must become, when its projected continuation to Heidelberg on the one, and to Hanover and Hamburg on the other side, shall be executed.

The railway traverses a very interesting country. In passing over it, the Taunus Mountains are constantly in sight. It follows the course of the river Main to Cassel (or Castel) opposite Mentz, and then turns off to the right towards Wiesbaden. About midway between the latter two places a short branch leads off from the main line to Biebrick, the beautiful residence of the Duke of Nassau, on the river Rhine. There are many curves in the line of the railway, which, however, are generally very gentle, the smallest radius of curvature is 2,300 feet. The branch to Biebrick is connected with the main line by two short curves of only 328 feet radius. There is a straight line from Frankfort to Hochst, of five miles, and another from Hochst to Florsheim, of seven miles in length. The total length of the railway is as follows, viz:—

|                             |   |   |   | Metres. | Miles.   |
|-----------------------------|---|---|---|---------|----------|
| From Frankfort to Cassel,   | - | - | - | 33,329  | or 20.70 |
| From Cassel to Wiesbaden,   | - | - | - | 8,620   | 5.35     |
| Branch railway to Biebrick, | - | - | - | 1,434   | 0.89     |
|                             |   |   |   | 43,383  | 26.94    |

or very near twenty-seven miles.

There are, in the whole, forty changes in the gradients of the railway, which vary from level to an ascent of  $28\frac{1}{2}$  feet per mile. The railway descends from Frankfort to Wiesbaden, but undulates to conform with the natural surface of the ground.

The construction of this road resembles that of the English railways, of which it is an imitation. The excavations and embankments were made for a double track, the width of the road bed is twenty-four feet, and is divided as follows:

|                                                  |   |   |   | Ft. | In. |
|--------------------------------------------------|---|---|---|-----|-----|
| From centre of road bed to centre of inner rail, | - | - | - | 3   |     |
| From centre to centre of rail,                   | - | - | - | 4   | 11  |
| From centre of outer rail to edge of slope,      | - | - | - | 4   | 1   |

Half width of road bed 12 feet.

The clear width of the track is, as in England, four feet eight and a half inches; the bridges and culverts were all built of stone, with the exception of two over the fortifications at Cassel, which have a wooden superstructure. The longest bridge is that over the Nidda, which has three arches of thirty-three feet span each. The embankments, erected principally from earth taken alongside of the railway, are generally very low, the highest being twenty-nine feet; the deepest cutting is only thirteen feet. At an average, the Company has paid 2d. per cubic yard of earth excavation, and 9s. per cubic yard

of masonry. The wages of a common labourer were, at the time of the construction of the railway, from 10d. to 1s. per day; those of a mason, or carpenter, 1s. 6d.

The superstructure is made in the following manner:—upon the surface of the road bed is a layer of broken stone, or gravel, ten feet wide for each track, upon which are put stone blocks, where the railway is in cutting, or even with the natural surface of the ground, and cross wooden sleepers on embankments. The stone blocks are of red sand stone, brought from Ashaffenburg, in Bavaria, about forty miles from Frankfort, and measure twenty-six inches square by thirteen deep. Their sides parallel to the line of rails, five under each rail, (of  $15\frac{1}{2}$  feet in length,) but so that those nearest to the joints of the rails are two feet ten inches from centre to centre, and those under the middle of rail, three feet three and a half inches. The wooden sleepers are of oak timber, half round and flattened on the top only, where the chairs rest, eight and a half feet in length, and seven inches high; they were put at the same distance from each other as the stone blocks. The price of a sleeper, delivered to the railway, was 4s. 6d., that of a stone block, 4s. 3d., or nearly the same. The iron rails are of a pattern similar to that on the London and Birmingham railway, weighing fifty-two pounds per yard, rest in chairs fastened upon every block, or sleeper, and are kept fast in the same by wooden filling pieces driven in outside the track. The chairs at the joints of two rails weigh twenty-four pounds, the intermediate ones, twenty pounds. A piece of felt is laid between the stone block and the cast iron chair, to diminish the bad effect occasioned by the roughness of the former. The space between the stone blocks, or sleepers, was filled out with broken stone, or gravel, up to the lower edge of the rail, and to a width of five feet on each side from the centre of the track. The remainder of the space between the gravel bed and the slope was filled up with earth to the same height as the gravel, with a fall of five inches to the slope. At intervals, from fifteen to thirty feet small channels were made in the banquette, and filled with gravel, in order to drain the foundation.

The Company has erected very spacious station buildings at Frankfort, Cassel, and Wiesbaden; shops for the repairing of locomotives, and carriages, are at Frankfort. Intermediate stations, where passengers are taken and left, are at Höchst, Hattersheim, Florsheim, and Hochheim. Water is always taken in at Hattersheim, and serves for two half trips.

There are at present, on the railway, six locomotive engines, from the manufactory of Robert Stephenson & Co., Newcastle-upon-Tyne; they have twelve (some thirteen,) inch cylinders, eighteen inch stroke, and six feet driving wheels; 100 passenger carriages of four different classes; the first and second class carriages are closed, and contain each eighteen seats, in three departments; the third and fourth class carriages are open on the sides, and have room for thirty to forty passengers. The carriages were manufactured partly in Höchst, and partly in Frankfort; the price of a second class carriage is £170, that of a third class one, £125.

Of the capital stock of the Company, (£250,000 sterling,) about £180,000 have been expended for the railway, buildings, fixtures, and material, which is at the rate of £6,667 sterling per mile. The chief engineer of this railway was Mr. Denis, who has also constructed the Nuremberg and Furth railway.

The Taunus railway has hitherto been used only for the transportation of passengers, and no arrangements have as yet been made for carrying also merchandize, &c. Since the road has been partly opened, in September, 1839, up to the 1st of July, 1840, the total number of passengers conveyed over the railway was 281,510, and the income £10,000 sterling. From April to July, during which period the whole line was in operation, the number of passengers has been 180,000.

There are daily five trips made between Frankfort and Cassel, and seven between Cassel and Wiesbaden, and the fares are, for a seat from Frankfort:—

|                        |   |   |   | To Mentz. |    | To Wiesbaden. |    |
|------------------------|---|---|---|-----------|----|---------------|----|
|                        |   |   |   | s.        | d. | s.            | d. |
| In 1st class carriage, | - | - | - | 3         | 6  | 4             | 6  |
| 2nd class “            | - | - | - | 2         | 5  | 3             | 0  |
| 3rd class “            | - | - | - | 1         | 8  | 2             | 1  |
| 4th class “            | - | - | - | 1         | 2  | 1             | 5  |

The fare for way passengers is the same in proportion to the distance. From the above, it appears that the charge per passenger per mile, is:

|                         |   |   |   |   |        |
|-------------------------|---|---|---|---|--------|
| In 1st class carriages, | - | - | - | - | 2.08d. |
| 2nd class “             | - | - | - | - | 1.38d. |
| 3rd class “             | - | - | - | - | 0.96d. |
| 4th class “             | - | - | - | - | 0.65d. |

Each passenger is allowed forty pounds of baggage; for every pound exceeding this quantity he is charged at the rate of about 0.4d. per lb., or 3s. 4d. per 100 lbs. for the whole distance from Frankfort to Wiesbaden. The charges for over-weight of baggage are, therefore, as high as for the same weight of passengers in carriages of the first class!

In the whole management of the railway a great want of ability and experience is every where visible; which, however, must be attributed in part to the circumstance that the work is yet quite new, and the first established in this part of Germany, and that the individuals employed (of which there are rather too many,) are yet inexperienced in their new business. Although the station at Frankfort is only a quarter of an hour's walk from the centre of the city, the omnibus calls at the different hotels generally three quarters of an hour before the time of the departure of the trains. On arriving at the station, passengers procure their tickets at the office windows, and on presenting the same are admitted into a large room, where they have to wait in a crowd, until ten minutes before the time of starting. At the ringing of the first bell the door is opened, when they may walk over a large yard to the hall, (so called,) under which the carriages are arranged. Five minutes after, the second bell rings, which denotes that no more tickets are to be sold, and at the sign of the third and last bell the train departs.



At an average, there are from twelve to fourteen carriages in a train; with this load the engines travel at the rate of twenty miles per hour. The engine-men regard fourteen carriages as a full load for the locomotives, if they have to travel at that speed. The fuel used is coke, made from coal on the Rhine; the quantity used for a trip between Frankfort and Wiesbaden, twenty-three miles, is 1200 pounds, and the price is 2s. per 100 pounds, delivered to the railway. The expense for fuel is, therefore, per mile of travel, nearly 1s.

Sixty men are constantly stationed on the line, for the purpose both of watching and repairing the railway; they receive £1 10s. per month, and are divided in several parties, over each of which a superintendent is appointed. For the trips, the Company employed six engine-men, and two superintendents in the repairing shops. Ten conductors are employed to accompany the trains.

The branch railway to Biebrich has only been lately opened, and is used with horse power. Passengers coming up the Rhine by steamboats, and having the intention to visit Wiesbaden, may leave the Rhine at Biebrich, or continue their journey to Mentz, from both places a few miles travel over the railway will bring them to the celebrated watering place. A long floating bridge over the Rhine connects the city of Mentz with Cassel and the railway.

[TO BE CONTINUED.]

## **Practical & Theoretical Mechanics & Chemistry.**

*Memoir on the Preservation of Timber.* By M. A. BOUCHERIE, M. D.

[CONTINUED FROM PAGE 99.]

I have nowhere found any traces of a serious study of the causes which produce alteration in wood. It has indeed been said, in a general way, that wood is rotted, either because moisture and heat united, set it in fermentation, or because worms are introduced into the substance, where they are spontaneously developed and indefinitely multiplied. But to my knowledge, no one has examined whether the different elements of wood contribute equally to this fermentation and generation of worms, or whether some peculiar and perfectly distinct parts of its tissue are alone the cause of it.

I have applied myself to obtain by experiment some definite fact in reference to this, and my observations have resulted in this simple, but important principle; *that all the alterations which wood presents are due to the soluble matters which it contains.* They alone, in contact with a certain quantity of water, the action of which is aided by a proper temperature, have the power of becoming heated, decomposing and furnishing a corrosive liquid which penetrates the woody fibre, alters its structure, destroys its resistance, and transforms it into a substance, which, by final analysis, presents many of the characters of ulmic acid.

It is these soluble matters alone, which possess nutritive properties, and which aid the development of those numerous and varied animals which sometimes devour even the most compact woods.

The facts upon which this proposition is grounded, have been observed more particularly in oak. This wood, containing a large quantity of soluble matters, and producing strongly marked re-actions with the salts of iron, appeared to me likely to present the most appreciable differences, and to permit the most rapid experiments. My predictions have been realized, and I here give the results which I have obtained.

1. Oak wood, completely rotted, contains scarcely any soluble matters, and the proportion of these substances always follows the degree of alteration of the wood. The confirmation of this fact was obtained by means of washing saw-dust, of timber altered in different degrees. The waters used were concentrated, after mixing with a known weight of sand, which allowed them to be dried, without decomposition; and the weight of the soluble matters was determined by weighing the whole mass, from which weight that of the sand was subtracted.

The saw-dust from good wood gave me from five to six per cent. of soluble matter; that which was altered, gave less and less, descending to one per cent., and even to a fraction of one per cent. when the rot was general, and well advanced. In many of my experiments I confined myself to judging of the alteration of the wood, by the more or less energetic action which it presented, in contact with salts of iron. I traced upon a suspected piece, a line with a solution of a salt of iron, and the intensity of the colouring, indicated with sufficient exactness, in rotted wood, what was the degree of their decay. Some pieces, entirely decomposed, gave not a trace of tannin. I will mention, upon this occasion, that the study of the alteration of certain woods, conducted in this way, permits us to make some interesting remarks. I have thus recognized altered points disseminated in the midst of healthy parts, and long lines of decay placed between other lines which remained in their natural state. Such facts raise a doubt as to the homogeneousness of the tissue of wood.

2nd. If we take equal quantities of washed and unwashed saw-dust, equally dry, and moisten them with equal quantities of water, taking care to compensate equally in each case for the loss by evaporation, it always happens that after a certain number of days, that which was unwashed, becomes covered with a thick mould, while after six months, the washed saw-dust presents no indication of the kind. Examining their weight, after this lapse of time, we shall find that that of the washed saw-dust has remained the same, while that of the other has greatly diminished. I have not determined whether gases are disengaged during the process of alteration, but every thing leads me to believe, that by a proper arrangement of the experiment, I should have been able to detect the disengagement of gases, and determine the nature of them. I shall hereafter examine this fact, in every aspect of interest which it may present.

3rd. Finally, when we follow attentively, in the various channels which they bore in the wood, those large worms which destroy it so rapidly, we quickly perceive that they advance only by powdering the woody substance which they find before them, swallowing it, and

then discharging it either in the state of an impalpable powder, or in masses in which vestiges of fibrous organization are still found. The wood, before being traversed by this animal, yielded to water seven per cent. of soluble matter; after, it yielded a much smaller quantity, rarely amounting to two per cent.

I do not think it proper to swell the list of these facts with those I obtained from the examination of fruits and green stems. The conclusion to which I came, was, that since the soluble substances in wood, are the causes of the alterations which it undergoes, it is necessary, in order to preserve it, either to remove these soluble matters by some means, or to render them insoluble by introducing substances which will thus deprive them of their fermentable and nutritious qualities.

The removal of the soluble substances could only be effected by a species of washing, and although I judged it, *a priori*, to be impracticable, yet I desired to study the interesting facts which might be presented by experiments upon it, and to prove, by actual observation, the inefficacy of the process.

The following are the results of numerous experiments, into the detail of which it is not worth while to enter.

1st. That the penetration of wood, when plunged into water, is extremely slow, and that, for instance, pieces of oak three feet in length, and nine inches in diameter, continued to increase in weight after ten months maceration. Duhamel proved, a long time since, that parallelopipeds of two inches in height, by one inch square, did not become stationary in weight until after six months immersion.

2nd. That submerged wood discharged very slowly a portion of the soluble substances which it contained, and that this loss was sustained only by the exterior layers, even after a very prolonged submersion.

Having thus satisfied myself that the removal of alterable substances was not practicable, my next task was to seek the means of transforming them into insoluble bodies, in the tissue of the wood itself.

In order to arrive at a solution of this problem, I examined, in the first place, the re-actions which the soluble matters underwent by the action of various chemical re-agents, and when I had assured myself that all salts with an insoluble metallic base precipitated them abundantly, I sought for that, the two components of which should present the greatest advantages under the double aspect of preservative action and cheapness.

The impure pyrolignite of iron appeared to me to unite all the conditions desired.

1st. It is cheap.

2nd. Its oxide forms stable combinations with almost all organic matters.

3rd. Its acid has no corrosive properties, and is volatile.

4th. It contains the greatest proportion of kreosote which an aqueous liquor can dissolve, and it is not now doubted but that this substance protects, with great power, all organic substances against the alterations to which they are liable.



The facts upon which I rest, in declaring these properties, are of two orders—the first, indirect, have been determined from vegetable substances of a very alterable nature, or from saw-dust; the others from timber itself, and these latter present so strong a confirmation of the preservative qualities of the pyrolignite, that they may be already cited as conclusive and decisive.

I shall record them both.

1st. If we take vegetable substances of a very alterable nature, such as flour, the pulp of beets, or carrots, a melon, &c., (which differ from wood, which they resemble in origin and constitution, only by the greater quantity of soluble matters which they contain,) and after preparing them with the pyrolignite, by simple immersion, we leave them to themselves, alongside of similar substances, not thus prepared, and which, in other respects, are under similar conditions of surface, contact with air and moisture; we shall always remark, that if we have used a sufficient quantity of the pyrolignite, we will succeed perfectly in the preservation of these, while the others will exhibit the ordinary course of alteration. I refer to the first table for the detail of the results obtained from flour, and the pulp of beets, placed in contact with various chemical agents, or left to themselves in their natural state. This table may be used as a measure of the degree of protection exercised by various substances.

The experiments upon the melon are remarkable, and appear to me to give the strongest idea of the protective effect of the pyrolignite against the decomposition, which, in this fruit, is so rapid. In all my experiments I proceeded comparatively; the same melon was cut into two parts, one of which was immediately put upon a plate, and the other immersed in the pyrolignite, withdrawn from it after a few hours, and placed upon another plate alongside of the former. The unprepared parts always present the ordinary alteration—the prepared part had acquired a perfect unalterability; it slowly dried, and finally acquired the hardness of wood.

2nd. In treating wood saw-dust by the pyrolignite of iron in an unconcentrated solution, we observe results similar to those which I have just mentioned. In the oak saw-dust, the presence of tannin causes a very deep black tint to appear, which prolonged washing does not diminish. The oxide of iron forms a solid combination, and the greater part of it is found again in the ashes obtained from burning the saw-dust. Abandoned, when moist, to themselves, without preparation, they would have been rapidly covered with mould; the mixture once effected, they alter no more.

I have not been able to trace the slightest indication of alteration during an experiment which lasted six months.

This double fact, of the black colour, and the decomposition of the salt by organic substances, is much more marked in oak than in the white woods, in all of which, however, it is found, wanting only in intensity.

In reference to the question of economy, I was desirous of determining what quantity of the pyrolignite was absolutely necessary to render insoluble all the alterable elements of wood, and I have satis-

fied myself that one-fiftieth part of the weight of the green wood is more than sufficient to produce this effect. This determination was easily made by isolating these substances, by washing a known weight of saw dust, and estimating the quantity of the pyrolignite which it was necessary to add to it, in order to precipitate, completely, all the soluble substances upon which it could act.

I am convinced that among the numerous substances which constitute the soluble matter of wood, tannin and albumen are not the only ones which are rendered insoluble by the salts of iron, but I cannot as yet designate the others. I have undertaken a long examination of this subject, which has not as yet terminated; they alone constitute a work, the extent of which may be estimated by considering that it was necessary to begin by studying the matters themselves.

The direct facts obtained with the wood itself, are the subjects of experiment at the moment of writing this memoir, and in order to diminish the time of the experiment, I have selected a species of wood, much used, and especially employed for the hoops of barrels, which always rot in a short space of time.

This wood was penetrated by the pyrolignite by means of a process which I shall mention to the Academy directly. A committee was appointed by the prefect of the Gironde, to examine these experiments, and under their eyes, in December 1838, I caused to be placed upon the same casks, prepared hoops, and the best hoops of commerce, in their natural state. These casks were then placed in the dampest parts of the cellars. Already (10th of August,) a deep and complete decay is shown by the hoops in their natural state, while those which were prepared, have not undergone any sensible alteration.

I have the honour to submit to the Academy, the official report of this experiment. If the result is shown to be constant, by the prolongation of the experiment, that the natural wood has been for a long time worm-eaten, while the prepared wood has remained entirely untouched, I hope that we may be allowed to reason from chesnut to other woods, and to conclude, that there is great probability of success in executing important works with wood prepared by impure pyrolignite of iron.

I will not conclude without remarking, that, although I give the preference to the pyrolignite of iron as a preservative, I do not exclude certain neutral salts, much in use, such as the chlorides of calcium and sodium, (muriate of lime and common salt.) These salts are likewise very efficacious, but only in cases where the wood is not constantly wet. The sulphate of soda is also useful, although it acts in the opposite way from those which I have just named. I have observed, also, that it dries wood with great rapidity. Fearing lest the hopes which I had founded upon the pyrolignite should be overturned by direct experiments upon wood, I took care to prepare some dozens of hoops with the chlorides of calcium and sodium, either alone, or mixed with the pyrolignite. These hoops were also placed upon barrels, along with hoops prepared with the pyrolignite alone,

and abandoned like them, and during the same length of time, to the destructive action of the damp air of the cellars.

The preservation was as perfect as that of the hoops prepared by the pyrolignite alone, and in addition, the flexibility was maintained as perfect as it was upon the first day of the experiment. From which I conclude that the preservative powers of the alkaline chlorides in wood, which is not constantly in water, equals that of the pyrolignite.

I shall shortly present to the Academy facts of the highest interest upon this subject.

[TO BE CONTINUED.]

*On the Fermenting Capacities of the Sugars.* By HENRY ROSE.

Translated for the Journal of the Franklin Institute, from "Poggend Annalen," for 1841.  
(Vol. 52, No. 2.)

In chemical and technical works, it is customary to divide the varieties of sugar into those capable of fermentation, and those which are infermentable. Among the former, are ranked cane sugar and grape sugar; among the latter, those derived from milk, manna, &c. We know, however, since Pallas' "Travels in Siberia," that milk sugar may be made to ferment, and that the milk of the cow, or mare, will readily afford intoxicating liquors by fermentation; and Schill and Hess have latterly proved, by experiment, that the crystalized sugar of milk is fermentable. It is highly probable that this sugar is first changed into grape sugar, which then causes fermentation, but the change is very slow, and even other substances, which cannot be ranked with sugars, such as starch, and several kinds of gum, but which contain oxygen and hydrogen in the same proportion as water, pass into the vinous fermentation more readily than sugar of milk, by the addition of substances containing nitrogen.

It appears that our elementary works neglect noticing the great difference in the fermentability of cane and grape sugar, and yet the circumstance is undoubtedly of great interest in the arts. It is, the more remarkable as the difference is so striking, that we might be inclined to rank cane sugar with those incapable of fermenting.

If to equal weights of grape and cane sugar, dissolved in equal quantities of distilled water, we add small but equal, quantities of yeast, the solution of grape sugar often commences to ferment at a medium summer temperature of 16° R. (68° F.) while the other remains unchanged. While the fermentation of the former may be accomplished in a few days, the solution of the cane sugar may remain unaltered after the lapse of several months, even if the temperature should reach 77° or 100° Fahr.

The grape sugar employed in these experiments was perfectly pure, and of a white colour; the cane sugar was pure and crystalline. An ounce of each was dissolved in five ounces of water, and pure yeast added to the solutions. In order to employ equal quantities of the latter, it was always used of the same pasty consistency, so that two small tea-spoonsfull weighing 1.57 grammes, when dried in a water-bath, gave a horny mass, weighing 0.27 grammes. This quantity of



barm was entirely sufficient to induce rapid fermentation in the grape sugar, while it left the other unchanged, after the lapse of a month. Indeed it requires six times as much yeast to bring the latter to a slow fermentation, so that if it were required to ferment solutions of the two sugars equally, and in equal times, it would be necessary to employ seven or eight times as much yeast with the cane as with the grape sugar. Common brown sugar acts similarly to the refined, requiring a large quantity of yeast to induce fermentation.

In the fermentation of cane sugar, it evidently passes first into the state of grape sugar, and the larger amount of yeast which it demands is necessary to bring about this change. The capability of fermentation of cane sugar depends, therefore, on the same principles on which several kinds of gum and milk sugar are subjected to fermentation, under certain conditions. They are changed by the action of several agents first into grape sugar, which then undergoes vinous fermentation. But the cane sugar suffers this change more readily than all other vegetable substances, and hence it is usually ranked among fermentable sugars. It can, however, be no more considered as a substance capable of the vinous fermentation, than starch, the gums, or even sugar of milk, the latter substances, it is true, suffering the change more slowly, and with greater difficulty. Grape sugar is, therefore, the only fermentable variety, and indeed the only substance which can be decomposed by yeast into alcohol and carbonic acid, and all substances which suffer the vinous fermentation must previously pass into the state of grape sugar.

Liebig discovered that ammonia is present in the sap of many plants containing cane sugar, such as the maple and birch.\* It has long been known to exist in the juice of the beet root. Possibly the ammonia, in its carbonated state, saturated the acid in the sap, thereby preventing the latter from converting the cane into grape sugar. For we find that the latter, and not cane sugar, is contained in the juices of all fruits, which possess both a sweet and acid taste. It is very possible, and indeed highly probable, that this sugar was at first contained in the juices as gum, or perhaps as cane sugar, and that these substances are converted into grape sugar by the gradual action of vegetable acid. If a sweet organic substance contains acid, the sweet taste must depend upon the presence of grape sugar. It appears that fixed organic acids induce the formation of grape sugar, for I found that the fermentation of cane sugar is more accelerated by cream of tartar than by any other substance. An ounce of cane sugar dissolved in ten ounces of water, and treated with two teaspoonsfull of yeast, as in the above experiments, began to ferment upon the addition of a drachm of cream of tartar; acetic, or sulphuric acid, did not produce the same effect.

\* Chemistry applied to Agriculture and Physiology.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Remarks Relative to the Fossiliferous Ore of Pennsylvania, and its Employment in the Manufacture of Iron.* By PROF. J. C. BOOTH.

In the course of a recent tour on the Susquehanna, I had an opportunity of making a few observations relative to the iron manufacture, some of which I believe to possess sufficient value to be laid before those who are interested in this foundation of national wealth. Indeed it is desirable that a freer interchange of sentiment should be maintained on this subject, and as many iron masters have made important observations in the course of their practice, I would suggest to them that their own interest lies in communicating such knowledge to the public, by its inducing a reciprocity on the part of others; for competition is less to be feared in this manufacture than in all others, since the consumption of iron will increase, at least, in proportion with its production.

The hematites, and other ores of Pennsylvania, having been worked advantageously for a great length of time, I paid more particular attention to the "fossiliferous ore," which is beginning to be more appreciated than formerly, and for very good reasons. It is regularly stratified, easy of access, always lies in the vicinity of lime-stone, and is, in all probability, of very great extent. For a more full and comprehensive view of this deposit, I refer to the excellent series of Geological Reports, particularly the 2nd, 4th, and 5th, presented to the Legislature of Pennsylvania, by Professor H. D. Rogers, which are based upon the extensive series of observations made by that gentleman and his assistants.

At the Duncannon iron works, I was shown a portion of chilled iron, from the hearth stone of a furnace in which the soft variety of the fossiliferous ore had been employed. Beside pure silica, which separates, and appears sometimes to have suffered fusion in this situation, a considerable quantity of pure metallic titanium was disseminated through the iron, and in a few points, it had separated somewhat in the form of a crystalline efflorescence, in which the cubical form could readily be detected with a microscope, and in many cases, even with the naked eye. Upon referring to the analysis of this ore, (Report 2nd, p. 44; 4th, p. 191 to 195; 5th, p. 115 to 117,) no trace of titanium being mentioned, should not excite surprise, when we recollect the difficulty of detecting it, unless its presence should be suspected, and when we reflect on the small amount in the ore that might be requisite to precipitate an appreciable quantity of it on the hearth-stones. Beside, since this metal does not appear to combine with iron, nor to affect its quality, its detection in the ore is a matter of inferior moment, and I have merely introduced a notice of its presence from the interest with which it is regarded by those engaged in scientific pursuits. Another method by which it may be detected is to observe when the slag assumes a fine blue colour, for

Karsten has lately discovered that this colour of the slag is due to the oxide of titanium.

A few hints may not be considered irrelevant in regard to the reduction of iron, which occurred to me in observing the ordinary processes, particularly at Danville. In roasting ores, which is generally regarded as an important preparatory step to their reduction, it is inadvisable to employ too strong a heat, for then the earthy materials and metallic oxide enter into a state of incipient fusion, which can be but imperfectly reduced in the furnace, and generally flow to the hearth in the state of slag. For although the carbonic oxide will act reducingly on its exterior surface, the inner, being completely enveloped in a compact cinder, can scarcely be affected. Probably the hard siliceous ore requires less heat than most of the other ores of iron, and indeed I give it as my conviction, that if the cost be not too great, it would be infinitely better to subject it to a coarse pulverization by mechanical means, since there is so small an amount of volatile matter in it, that simple roasting will not render it sufficiently porous. If roasting the ore be still adhered to, nothing should be more strictly watched than the object in view, which is to drive off volatile matter, and render the ore brittle and porous, and nothing can be more injudicious than to apply a heat which will cause the ore to cake together, or become cindery, since it is then more difficult of reduction than the ore in its original state.

Another point that cannot be too much insisted on is the due and proper mixture of ores, and it might almost seem as if nature pointed out the propriety of this, in presenting the three varieties of ore in the same locality. It is a well ascertained fact, that a very large quantity of lime is requisite to bring silica into a fusible state, such as is necessary in the operations of the iron furnace, while a small proportion of alumina, in addition to those substances, requires less lime, and a much less intense heat, to form a perfect slag, or glass. Now it appears, from analysis, Report 5th, p. 116, that the siliceous ore consists almost wholly of peroxide of iron and silica, with only one-half per cent. of alumina, and that the calcareous variety contains none, and Report 4th, p. 192, the hard ore contains a mere trace of alumina. In Report 2nd, p. 44, the porous and soft ore contains five per cent. alumina, and in Report 4th, p. 191 and 192, a similar ore includes five and six per cent. of the same earth. Hence it appears that the chief deficiency of the hard and calcareous ores lies in the want of alumina, which is contained in the soft ores; and that they should, therefore, be mingled in due proportion. If it is not always practicable to obtain a sufficient amount of aluminous ore for this purpose, the importance of having alumina present is such that it would become advisable to employ an argillaceous lime-stone as a flux, or even to use a clay, or other argillaceous material. If these points were to receive the attention they merit, I am convinced that iron masters would not so often complain of the difficulty of reducing hard varieties of ore.



## Architecture.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*A Description of the Philadelphia County Prison, and the Debtors' Apartment. Designed and Executed by THOMAS U. WALTER, Architect.*

The Philadelphia County Prison is situated on the Passyunk road, about one mile south of the city. It occupies a space of 310 feet front by 525 feet in depth, with an addition on the north of 150 by 340 feet.

The façade consists of a centre building of fifty-three feet in width, with receding wings on either side, of fifty feet, flanked by massy octagonal towers. Beyond these towers, receding wing-walls are continued to the extremities of the front, and terminated with embattled bastions.

The whole exterior is composed of a blue sienite, obtained from Quincy, in the State of Massachusetts.

The style of architecture is that of the castles of the middle ages, and its decorations are in the *Perpendicular* or *Tudor* style of English Gothic.

The centre building is three stories in height, diminishing at each story in regular offsets, capped with a projecting belt. The corners are finished with circular warder towers of five feet four inches in diameter, commencing at ten feet below the top of the front wall, and extending five feet above it; these towers project *three-fourths* of their circumference over the corners of the building, and are crowned with embattled parapets, supported by corbels. The front wall, and both the flanks, are also finished with battlements, pierced with embrasures, thus forming an embattled screen between the towers, and imparting a tower-like effect to the whole centre building.

The wings are two stories in height, and contain the gates of entrance, each of which is ten feet wide, and seventeen feet high. These wings, and the octagonal towers which flank them, are pierced with slip windows, and finished with embattled parapets, in the same manner as the centre building.

The bastions, on the extreme angles of the front, are also crowned with pierced battlements corresponding with the rest of the design. They project two feet from the wing walls, and measure, on each face, fifteen feet in width at the base, and thirteen feet at the top.

The centre building is surmounted by an embattled octagonal tower, which rises to the height of seventy-seven feet from the ground.

The interior is disposed in two general divisions, one for untried

prisoners, and the other for male convicts, whose term of service does not exceed two years; the female convicts being confined in a building on the adjoining lot.

The main prison contains 408 separate cells, built in two blocks of *three* stories in height, extending from each wing at right angles with the principal front. The cells open into a corridor of twenty feet in width, occupying the centre of each block, and extending the whole length and height of the building. The second and third stories are approached by means of granite stair-ways and galleries, supported on strong cast iron brackets; a clerk's office is situated at the head of each corridor, from which every cell-door in the whole range may be seen at the same moment.

Each cell is nine feet wide, thirteen feet long, and nine feet high, substantially arched with bricks, and floored with oak plank. They are all furnished with separate hydrants, water closets, flues for ventilation, flues for admitting fresh air, and flues for admitting warm air, generated in furnaces placed in the cellar of the building.

The furnaces are constructed at each end, and in the centre of each block, and the warm air is conveyed along passages of *three* feet in width, under the pavement in the corridor. The smoke flues are formed in these passages, the bottom and sides of them being composed of bricks, and the top, of cast iron plates; these flues extend horizontally from the main furnaces at each end, to the centre, where they rise perpendicularly to the top of the building; an ascending current is produced in the vertical portion of each flue by means of small furnaces constructed in the centre, and which are also made to impart heat to the cells adjacent to them; by these means an active current is formed in the horizontal flues, and heat is conveyed along the whole range, in sufficient quantities to keep all the cells of an agreeable temperature.

Each cell has a wooden door on the outside face of the wall, and an iron one on the inside; both doors are secured to a cast iron casing, or frame, which extends through the whole thickness of the wall.

The hydrants and water closets are supplied from *twelve* reservoirs placed near the roof of the building; these reservoirs receive their water from the works at Fairmount.

The kitchen, bake-house, laundry, and bath-houses, are situated in a separate building, occupying a space of forty-three feet wide by seventy-two feet long, in the yard between the two blocks of cells; they are approached from both divisions of the prison, by means of covered passages.

The kitchen is furnished with a large steam boiler, and four cast

iron reservoirs, of eighty gallons each, in which all the boiling for the prisoners is done by steam.

*The apartment for females* is situated in an adjoining enclosure, of 150 by 340 feet, entered by a gate-way from the yard of the main prison; the building measures 43 by 282 feet, and consists of two stories in height, embracing 100 separate cells, of eight feet by twelve, a suite of rooms for an infirmary, of twenty by fifty-one feet, and two rooms for a keeper, each twenty by twenty. The arrangements for hydrants, water closets, warming and ventilation, are similar to those already described.

The principal entrance to this portion of the establishment, is from Eleventh street; it consists of a gate-way of nine feet in width, placed in the middle of a projecting centre of fifty feet, composed of brown sand-stone, and finished in the simplest style of Egyptian architecture. The whole western front is built of the same material, and in the same style.

#### *The Debtors' Apartment.*

This edifice is situated on the Passyunk road, north of the main prison, and east of the female apartment; it presents a front of ninety feet, composed of brown sand-stone, in the Egyptian style of architecture. The façade consists of a recessed portico, supported by two columns, proportioned from those of the Temple of the Sun, on the Isle d' Elephantine, in Egypt. The windows are crowned with the massy bead and cavetto cornice peculiar to the style, and the top of the building is finished in the same manner. A winged globe is carved in the cavetto of the main cornice, and a similar ornament is introduced over the door.

The aggregate cost of the whole work was upwards of \$450,000; the County Prison was founded in 1832, and finished in 1835; the debtors apartment was built in 1836, and the apartment for females in 1837 and 8.

T. U. W.

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### **Mechanics' Register.**

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LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1840.

*With Remarks and Exemplifications by the Editor.*

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1. *For a Galvanic Paint for Protecting Iron from Decay by Rust;*  
Lewis Knapp, New York, July 1.

This patent was taken for "a process in the manufacture of materials for galvanizing iron, or protecting iron from decay by rust, or decomposition." The specification is one of much length, and a general outline of the process would occupy more space than we can



allow to it; we therefore simply give the claims, which are as follows, viz. "What I claim as new, and of my own discovery and invention, is first forming of a galvanic paint for coating utensils of iron by pouring a mixture of lead and zinc, or lead, zinc, and tin, on a quantity of copper and sal ammonia, placed in the bottom of a vessel, so as to form an oxide of said metals, and afterwards combining with the oxide so formed, a further quantity of copperas and sal ammonia, as described. Second, I claim as new, and of my own discovery and invention, the combination of a portion of lime with the galvanic powder so produced, when such combination is used, for the purpose of economizing the galvanic powder, and making the paint so mixed, harder, and more adhesive. Third, I claim as of my own invention and discovery, the mode herein set forth, of forming an alloy of zinc and lead, or of zinc, lead, and tin, by pouring a mixture of said metals, in a melted state, on a quantity of copperas and sal ammonia, which unites with the grosser parts, and allows the purer parts to escape through the bottom of the vessel, as described."

This compound is manifestly empirical, and must be inferior in its protective influence to the paint claimed under M. Sorel's patent, whilst if it possesses any good properties they are due to the same cause which gives value to the latter.

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2. For *Making and Attaching the Heels of Boots and Shoes*; Samuel Warner, of Lowel, Vermont, Jere Hodgkin, of Westfield, Vermont, and William E. Truver, Watervliet, New York, July 1.

The improvement consists in making a hollow shell of the form of the heel, either of metal, horn, bone, or ivory, which is to be attached to the boot, or shoe. The inside of this shell is to be filled up with India rubber, cork, leather, or other elastic substance. About midway between the bottom and top of the shell there is a flanch, by which it is screwed to the leather of the heel of the boot, or shoe.

The patentees say, "What we claim as our invention, and desire to secure by letters patent, is the manufacturing and attaching metallic, horn, bone, or ivory heel cases, the hollow part below the flanch to be filled up with India rubber, cork, or leather, or any other suitable material, and combining therewith, or attaching thereto, a spur, when necessary."

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3. For *Coupling Irons for Preventing Railroad Carriages from Running off the Track*; Thomas G. Owen, Baltimore, Maryland, July 1.

The coupling irons, which are the subject of this patent, are each made of two pieces, jointed together at one end, like a carpenter's rule. The holes through which the coupling pins pass are drilled through when the two pieces are closed, so that one-half of each hole is in each half of the coupling irons; one of them is made near to its jointed end, and the other at the distance of a few inches from the opposite end. When the coupling iron is in place its two halves are held together by the passing of that end which is not jointed, into a

mortise in a sliding bar, by which the two parts are held together whilst the two cars are in a line with each other, or whilst they deviate no further from this than is occasioned by the curvature of the track. But should the locomotive, or a forward car, run off the track, the coupling bar will be released from the mortise in the sliding bar, and its parts will separate from each other, and disengage the cars. The claim is to "the method of coupling railroad cars, or carriages, by means of the double coupling irons, in combination with the sliding bar, for the purpose, and in the manner, substantially, as herein described."

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4. For *Arranging the Cylinders of Steam Engines, so as to Prevent the Dead Point in the Crank*; Caleb L. Ferris, Courtland, West Chester county, New York, July 1.

The patentee says, "What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the horizontal and vertical cylinders, that is to say, I claim placing said cylinders (whether one be horizontal, and the other vertical, or otherwise, providing their relation to each other be still the same,) at right angles, or nearly so, with their closed ends adjoining each other, and the crank, or main shaft between them, at the junction of the angle, and operating the cranks by means of having the connecting rods of both cylinders attached to them."

The placing two steam cylinders, with their axes at right angles, has been heretofore done, and with the same object in view as that above stated; but the novelty, in the present instance, consists in the placing the two closed ends, or what usually constitutes their bottoms, close to each other, with the crank shaft so situated as to occupy the space between said closed ends. From the crank, or rather cranks, connecting rods extend to the pistons of each cylinder, in the ordinary way. By the above arrangement a great part of the room is saved, which was uselessly occupied by the connecting and operating parts, on the former plans of placing the two cylinders; so far, certainly, this may be considered as an improvement.

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5. For *Door Springs*; Gardner Barton, Sr., Shaftsbury, Bennington county, Vermont, July 1.

This is a spring for closing doors. A standard is attached to the upper part of the door, having a roller on the upper end of it, which roller acts against a lever attached to a segment of a cog wheel. The segment cog wheel turns on a pin, which connects it to a bar attached to the casement above the door, the segment meshes into a rack, which has a rod at one end of it, around which a spiral spring is wound. The spring is attached by one end to the bar, and by its elasticity forces the rack out, and acts upon the segment and lever, the latter of which, by bearing against the roller on the standard attached to the door, keeps it closed. The claim is to the combination and arrangement of the spring rack, segment, and lever, and the roller attached to the standard.

6. For a *Portable Railway for Removing Earth, &c.*; Jarvis Ring, Ogden, Monroe county, New York, July 1.

This portable railway is for removing earth, or other articles, to a short distance, and depositing it at one end of the railway. The description is given at great length, but the purposes to which it is to be applied are not very distinctly set forth. The cars, or trucks, are to run upon rails, extending the length of the apparatus, and are to return in an inverted position, under these rails; in order to enable them so to do, the ends of the upper rails are rounded, so as to form a semicircle, and around these the cars, or trucks, pass; when they have so passed, the wheels are supported on under rails, along which they return to the opposite end of the portable railway, where they ascend, by passing round a semicircular curve, and are ready to be re-loaded. The truck, or cars, are jointed, and otherwise so constructed as to enable them readily to pass round the semicircular ends of the track; they are connected together by a band, and motion may be given to them by means of a winch, or crank. The whole structure must, of course, be sustained by suitable frame work. The claim is to "making a double railway, with one track above the other, and rounded off at the ends, to unite the two, so that cars attached to endless chains, or belts, can run upon the two tracks."

7. For improvements on the *Cylinder Mill for Grinding Corn*; Harvey W. Pitts, Wilsonville, Shelby county, Alabama, July 1.

Two cylinders of stone are placed side by side, and made to revolve with different velocities. Their axes are horizontal, and a double concave of stone is made to occupy the space between them on their upper sides, thus forming a rubbing surface between the concaves and each cylinder, equal to about one-fourth of its surface. A vibrating motion is given to the concave by means of a cam, or otherwise, and it is borne up against the cylinders by suitable means. The claim is to the "double vibrating concave, in combination with the fast and slow moving cylinders."

8. For improvements in the *Steel Writing Pen*; David Thomas, Hingham, Plymouth county, Massachusetts, July 3.

These improvements in the steel writing pen consist in a peculiar mode of making the pen in two pieces, so formed as to give the elasticity above the nib, instead of to the nib itself; also in a manner of sustaining and securing the pen in the holder by means of set screws, and likewise in covering the holder with leather, gum caoutchouc, or any other elastic substance. Without the drawings the claim could not be understood; and we are apprehensive that the pens themselves will not pass into the hands of many of our readers.

9. For a *Machine for Drilling or Boring Rocks*; Simon Petter, Schenectady, Schenectady county, New York, July 3.

The drill stock slides in bearings in a frame, which frame slides up



and down, in an inclined frame, the respective parts being made adjustable in such manner as to give to the drill any desired inclination. The first frame slides in grooves in the inclined frame, and its height is regulated by cords attached to it, and passing over a roller at the top of the inclined frame. The inclination of the inclined frame is regulated by passing the screw bolts, by which it is secured, through long slots in the upper and lower side-pieces of the main frame—the upper bolts also pass through slots in the side-pieces of the *inclined* frame, to allow for the increased distance between the upper and lower bolts, when the inclination of the frame is increased. There is a circular plate on the drill stock, the under side of which is provided with cogs, or cams, which are tangential to a circle about half the diameter of the plate, so that when the tappets, by which the drill is worked up and down, act against these cogs, or cams, in lifting up the drill, it insures the turning of the drill. The claim is confined to the combined adjustable and sliding frames, with the drill, and to the method of raising and turning the drill, by means of the cogs, or cams, on the plate, and the tappets.

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10. For an improvement in the *File for Filing Papers*; William Mann, Philadelphia, Pennsylvania, July 3.

This file, for letters and papers, consists of two covers, like those of a book, at the back edge of each of which there is a thin plate of iron—one of these plates is provided with two holes, to pass on to two screws attached to the other. The papers to be filed are placed between the two covers, and by means of nuts and screws, the whole is so compressed as to hold the papers. The nuts are halved, and each half is attached to a spring, the two springs being united together at their upper ends, in the manner of a crayon holder, and the two half nuts are brought together when it is desired to screw the file tight, by means of a slide, in the manner of closing that instrument. As the screws are necessarily very long, the nuts may be put on and taken off, by opening and closing the slide, so that they are not required to be turned on the screws, excepting to tighten and loosen the file.

The claim is to the “construction of the divided spring screw nut, opening by the elasticity of the springs attached to the two halves, and united at top, and made to close by means of the sliding ring, and adapted to the file, in the manner described, for filing papers and letters.”

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11. For a method of *Attaching Artificial Teeth*; Alfred Riggs, City of New York, July 3.

The claim upon which this patent was granted, fully expresses the nature of the invention, and is as follows. “I rest my claim to invention, or improvement, in the making, or manufacture, of boxes, or plates, for mounting artificial teeth, upon the making, or forming, them of two parts, or plates, closely united together at the edges, so as to be air-tight, with a space, cavity, or hollow, between the plates,

either continuous, or divided into apartments. The inner plate, which rests upon the gums, being perforated with holes, more or less in number, through which the air is exhausted from the space, hollow, or cavity, between the plates, by suction, or otherwise, thus causing the boxes to adhere to the gums, by the pressure of the atmosphere, or air from without."

Perhaps teeth may be firmly held in this way, but to us it seems very doubtful, and most certainly, as a general mode, it cannot be applicable, the state of the gums and teeth, in most subjects, not admitting of such a mode of fastening.

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12. For improvements on the *Roller Gin for Ginning Cotton*; Fones McCarthy, Demopolis, Morengo county, Alabama, July 3.

In front of the rollers there is a plate, which extends their whole length, and vibrates up and down; its upper edge is serrated, and is called by the patentee, "a vibrating saw;" immediately above this saw is an adjustable plate, which can be moved up and down, to regulate the distance between its lower edge and the vibrating saw. The bottom of the hopper, which is to contain the seed, lies directly in front of the adjustable plate, is horizontal, and is grated. The drawing roller is placed behind the vibrating saw, its upper surface being on a level with the saw—it is covered with leather, has a spiral groove running around it, and has a weighted roller above it. Behind this last named roller is a receiving roller, which is covered with cloth, and around which the cotton winds after it leaves the drawing roller; a vibrating comb placed behind this strips the cotton therefrom. As the cotton is drawn between the adjustable plate and vibrating saw, by the draw roller, the vibrating saw loosens and strips the seeds. The claim is limited to the "arrangement of the vibrating saw, adjustable plate, and grooved drawing roller, for separating the seeds from the cotton, in combination with the receiving roller and comb."

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13. For *Applying Distemper Colours in Painting, &c.*; Francis Gybbon Spilsbury, Fawny Corhaux, and Alexander S. Byrne, of Great Britain, July 10.

The patentees say, "The object of our invention, whether in preparing pigments, or paints, and vehicles, or in the mode of applying them, relates to means of using soluble vehicles for applying paints, or pigments, which vehicles, by an after application of chemical agents, or re-agents, are rendered insoluble in water, and will thus allow of paints, or pigments, so applied, and so fixed, to be afterwards washed, in order to clean them, and will, at the same time, admit of paints, or pigments, and vehicles, so employed, being applied for the most elegant purposes of house, and such like, painting, and also to the purpose of the artist, and for printing paper, and other fabrics, and, at the same time, in their use, they will not emit that disagreeable smell consequent on using oils, or spirits, or varnishes"—again, in giving the rationale of their invention, they say, "It is well known

that many chemical agents, or re-agents, when brought in contact with gelatin, or albumen, in solution, coagulates them, and such coagulated substances, when dry, are insoluble, and such is the case with other matters which, as well as gelatin and albumen, are employed as the soluble vehicles for mixing with pigments, in order to their being used as paints, and by the subsequent application of chemical agents, or re-agents, such vehicles are rendered insoluble, and the paints, or pigments employed, fixed, or set."

When gelatin is used as the soluble vehicle, alum is employed to fix, or give permanence thereto, the patentees deeming this the best of the chemical agents for rendering gelatin soluble in water.

The extracts above given will afford a good general idea of the nature of the invention, and as the specification and claims are of great length, and the latter not descriptive without the former, we omit them.

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14. For *Stoves, or Air-heaters, for Heating Apartments*; George C. Howe, City of New York, July 10.

A semi-cylindrical drum surrounds one-half of a cylindrical fire-chamber, leaving a space between the inside of the drum and the outside of the stove. On each side, near the top, a short pipe connects the chamber of combustion with the semi-cylindrical drum—another pipe passes directly through the back to the chimney, and an elbow pipe connects the bottom of the semi-cylindrical drum with the pipe that leads to the chimney beyond the valve employed therein, to close the direct draught. When the valve in the pipe that leads to the chimney is opened, the draught passes directly out; but when it is closed, and a valve, in the pipe which leads to it, is opened, the draught passes out on each side into the drum, and thence through a pipe into the exit pipe. The air of the room circulates through the space between the fire-chamber and drum, and thus becomes heated. The claim is to the manner in which the cylindrical stove and drum are combined, "by making the drum surround the back part of the cylinder, and leave an open space between it and the latter for a current of air to circulate through, as described." "And also to the arrangement of pipes and valves, in combination with the above."

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15. For a method of *Hanging Doors*; William D. Beasom, and E. G. Reed, Assignees of George W. Wilson, Nashua, New Hampshire, July 10.

The upper hinge of the door is to be made with two tongues on one half of it, and with one on the other half; the hole through the latter is made conical from either end, so that the pin attached to the two horns of the first named half, will be allowed some play. The lower hinge is made with a pivot on the half attached to the door, which rests in a socket in the other half; and this pivot, instead of being plumb under the axis of the upper hinge, stands out some distance, so that the weight of the door will always tend to close it, un-



less it be opened beyond a right angle, when it will have the opposite tendency.

The claim is to "the construction of the upper hinge in combination with the lower hinge, arranged and operating together." The particular arrangement claimed has some novelty, but the general plan is old, doors, and particularly gates, having been frequently hung upon this principle.

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16. For *Making Card Paper*; Edward L. Perkins, Boston, Massachusetts, July 10.

The machine used by the patentee, consists of an arrangement of rollers which carry a sheet of paper over a revolving brush, which brush receives the paste from a bed, which is supplied from a reservoir; this brush spreads the paste on the sheet, and another brush takes off the surplus, the paper is then carried to two pressing rollers, where it is united to another sheet of paper, which comes from a roller above. The claim is to the particular arrangement of the respective parts of the machine, referring to the drawings, and not capable of being understood without them.

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17. For *Boxes for Carriage Wheel Hubs*; Nathaniel C. Day, Lunenburg, Worcester county, Massachusetts, July 10.

The washer, or shoulder, of the arm of the axle-tree, against which the inside of the hub is to bear, is made conical, its greater diameter being towards the hub—a cavity is made in that face of it which is against the hub, for the reception of grease, which, when the axle-tree becomes heated, supplies grease to the rubbing parts. The box is provided with a cylindrical flanch, which extends over the washer, or shoulder, on the arm; and over this extends a *gravel guard*, which is a semi-cylindrical hoop, attached to the bed piece of the axle-tree. The patentee says, "what I claim as my invention, and ask a patent for, is the combination of the conical periphery of the washer, the grease reservoir, the flanch of the box, and the gravel guard, as above described."

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18. For *Preventing the Escape of Sparks from Locomotive Steam Engines*; Francis B. Longmire, and H. Jones Brooke, Philadelphia, Pennsylvania, July 10.

The patentees say, "In the apparatus which we have invented for preventing annoyance from sparks, we make use, as is usual, of the escape steam, for the purpose of creating a draught through the fire; but instead of extending the waste steam pipes upwards, into a vertical flue, in the ordinary way, we carry said pipes downwards, so as to pass within a flue under the boiler; said flue may extend along, into, or below, the ash-pit, under the fire-box, so as to cause the sparks, with the waste steam, and the gaseous products of combustion, to be discharged into a compartment prepared therefor, or into the ash-pit, allowing their final exit to be downwards, on to, or towards,

the ground. For the purpose of economising heat, we, in general, construct a metallic water box, or chamber, made flat, enclosed on all sides, and of such size as to occupy the area of the fire box, and this, by means of suitable tubes, we connect with the water tank, so as to allow water to flow into it; and we also connect with it the tubes of the supply pump, so that the water flowing in from the tank on one side, and heated to a considerable extent by the heat from the ash-pit, and from the escape steam, on its passage to the opposite side, may go to supply the boiler."

"Having thus fully set forth the nature of our invention, and shown the manner in which the same is to operate, what we claim therein, and desire to secure by letters patent, is the extending of the exhaust steam pipes downwards, and into a flue passing horizontally along under the boiler, into a compartment in the lower end of the fire box, which compartment may consist of the ash-pit, or of one specially prepared for the purpose, substantially in the manner set forth. We also claim the manner set forth, of locating and using a water box, constructed in the way, and employed for the purpose herein set forth."

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19. For a method of *Making and Attaching Buttons*; Festus Heyden, Waterbury, New Haven county, Connecticut, July 10.

The button is made in the manner of the common brace, or suspender button, except that there is but one hole in the middle of the concave part; and it is attached to cloth by means of a broad headed rivet, the shank of which is put into the hole from the back, and riveted on by means of a concave punch. The claim is in the following words, viz. "I claim the method of attaching buttons to cloth by riveting, and of manufacturing the parts for that purpose, combined in the manner, substantially as specified."

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20. For *Wooden Pavements, and Building Horizontal Platforms*; Redwood Fisher, of New York, Assignee of Augustus Count De Lisle, Paris, France, July 10.

The blocks are shaped to represent two parallelopipeds crossed diagonally, so that the two upper and two lower sides may be upon the same plane, and the top and bottom parallel to each other, or two parallelopipeds may be united together to represent the same forms. These may be made of iron, stone, wood, or of any other suitable substance. The blocks thus formed, are placed in ranges, so that the two extreme angles of the parallelopiped of one block will overlap those of a block in the next range. In forming beams, two, or more, ranges are put together, from one abutment to another, the middle or key block of each range being formed of two equilateral triangles placed side by side, an angle of one, and a side of the other, being upwards, and the other reversed. The inclinations of the parallelopipeds being inclined in opposite directions from the key towards each abutment. It is not possible to give a clear idea of this arrangement without drawings. The claim is, first to the "mode of forming

or shaping, materials, or substances, for building, paving, and other purposes, according to the divisions of the cube herein described; and secondly, to the mode of employing, in combination for building, paving, and other purposes, blocks, materials, or substances, so formed, or shaped."

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21. For a *Refrigerator*; John Scott, Philadelphia, Pennsylvania, July 10.

The patentee says, "I construct my refrigerators principally, or entirely, of sheet metal, and make them either in the form of a parallelogram, a vertical cylinder, or oval, or in any other shape that may be preferred. In whatever form I make them, they are to consist of two cases of sheet metal, one placed within the other, so as to leave a space of an inch, more or less, between the two, which space may be occupied by air, or may be filled in with any fibrous, or pulverized, bad conductor of heat. My principal improvement in such refrigerators consists in my forming a chamber for receiving ice, in the upper part thereof; and a second chamber for the reception of the water produced by the melting of the ice in the lower part, with suitable openings for the passage of the water from one chamber to the other, by the descent of which cold water every part of the apparatus is cooled."

"What I claim as new, is the forming it with an upper and lower chamber, in the manner described, the upper chamber being intended to contain ice, and the lower to receive the water produced by the melting thereof, said water descending from the upper to the lower chamber through tubes, or channels, constructed substantially in the manner set forth, so as, in its descent, to exert its refrigerating influence within the refrigerator."

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22. For *Truss Frames of Bridges*; William Howe, Warren, Worcester county, Massachusetts, July 10.

The following are the claims on which this patent was granted, viz: "What I claim as constituting my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the braces and counter braces, the double posts, and the wedges between them, so that by the driving of said wedges the truss frame may be cambered in any desired degree; I claim the manner of carrying the same principle into effect by the combined operation of the wedges, or keys, over the arch beam, and those between the posts. I claim the application of the same principle by an arrangement of braces and counter braces, combined with an arch beam, the wedges, or keys, for cambering, being driven between the principal and resisting braces, in the manner set forth, together with such other modifications, or variations, of the same principle by which the same end may be attained, by means substantially the same."

In the first modification claimed, the posts, along the truss frame, are double, and the braces and counter braces run from one half post to the half post of the second section, crossing by the side of the two



half posts that form the division between the first and second sections; and the second set of braces and counter braces start from the half posts crossed by the first braces in either direction, and so on. Strings, of course, embrace the whole on both sides. The wedges for cambering are driven in between the double posts.

In the second modification, the posts are split from the top nearly to the bottom, the wedges being driven in at the top. The braces and counter braces extend from the bottom of one post to the bottom of the next, in each division. An arch passes through the truss from end to end, embraced, or straddled, by each post, and a key is used where each post rests on the arch, so that by driving the keys on the arches, and those in the split posts, the frame is cambered. In the third modification, the braces and counter braces, instead of reaching from post to post, in each division of the truss, nearly meet in the middle, and the wedge is driven in between them, to give the camber.

23. For a *Water Wheel for Driving Mills*; Joseph Hanchett, Cold Water, Branch county, Michigan, July 15.

The wheel referred to is a modification of the well known paddle wheel, in which the paddles are always kept vertical, by an eccentric guide wheel, or disk, at the side of the main wheel, the axis of each paddle having a crank, which works in the eccentric guide wheel, so that as the main and guide wheels revolve together the paddles enter and leave the water vertically, instead of radially. That which the patentee claims as an improvement consists of a method of changing the relative position of the main and guide wheels, so as to make the paddles enter and leave the water at a given inclination; and this is effected by having the shaft of the main wheel suspended in stirrups attached to two short shafts, on one of which the guide wheel works; on the end of these shafts are the levers, which change the position of the stirrups, and consequently the main wheel, relatively to the guide wheel. The line of the paddles will always be parallel with a line passing through the centre of the guide and main wheels.

The claim is as follows, viz: "What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the guide wheel upon the short axle, in combination with the main wheel, as suspended in stirrups fixed to the ends of short axles, turned by levers, for changing the position of the centre of the water wheel, in order to change the angle of the paddles, all as herein described." This, we suppose, will be just as good as some of the numerous analogous contrivances which have been made the subjects of patents, but neither of which has yet superseded the ordinary wheel, or even placed it in jeopardy.

24. For *Dressing Staves for Making Barrels*; Hervey Laws, Wilmington, New Hanover county, North Carolina, July 15.

This machine is intended for the dressing of rived staves, or of such as may be made from saw-mill slabs. The pieces to be dressed are to be cut to a suitable length, and they are delivered from the machine

of the proper convexity and concavity on their sides, and with their edges jointed. The staves are dropped, or fed, into the machine through a suitable opening, and by means of a follower, worked by a crank motion, the stave is first forced along a trough-like cavity, between knives, or cutters, for the purpose of removing all superfluous stuff, and passing on, it is then forced between, and against, a series of cutting irons, operating as plane irons, and held in stocks by wedges, or otherwise; one set of these irons give to it its proper convexity, and the other its concavity. From this part, which dresses its sides, it passes on to the part where its edges are to be jointed; and this consists of a curved trough, continued on from the straight part, last described. The curvature of this jointing trough is such as will allow the stave to pass without bending it, but with its middle against the convex, and its ends against the concave side of the trough, and in thus passing it is jointed by a series of plane irons acting on each of its edges, in such manner as to give the proper rake to the joints, and the proper bulge to the stave. Each stave is forced on by the one immediately behind it, and they are delivered in a finished state with great rapidity. There are but few machines for the same purpose which are so truly original, and so far as we are informed, but few the action of which is so perfect.

The patentee says, "what I claim as constituting my invention, and desire to secure by letters patent, is the manner of constructing and combining the part for dressing the faces of the staves, with a curved box, as set forth, and furnished with a series of jointing irons contained in stocks forming the upper and lower portions of said box; the faces of said plane stocks approaching each other on the concave side of the interior of said box, for the purpose, and operating, substantially, in the manner herein set forth." "I also claim the said curved box for jointing staves, in its individual capacity, the respective parts thereof being constructed and connected, as herein described."

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25. For an improvement in the process for *Manufacturing Fair Leather*; John L. Turner, Philadelphia, Pennsylvania, July 15.  
(See specification.)

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26. For an improvement in *Fire Chambers for Stoves*; Benjamin F. and Job S. Gould, New York City, July 15.

These fire-chambers are of cast iron, and are fluted on their outsides like the shaft of a column, and their inner surfaces correspond in form with their outer, as they are of equal thickness throughout.

The patentees observe that "by the yielding nature of the arches, (swells, or ridges,) and the transmission of the same caloric through the sides of the chamber with diminished intensity of heat, owing to the additional extent for this transmission, without injury to the draught, the iron will be rendered far more indestructible, effecting an improvement which cannot be attained by any other mode."

The claim is to that mode of constructing the chamber of combus-

tion, or what is usually denominated the cylinder of a stove, with flutes, or ridges, as above described.

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27. For an improvement in the *Planing Machine*; James M<sup>c</sup>Gregor, Jr., July 15.

This improvement is made on a planing machine originally patented on the 28th day of August, 1833, and noticed in vol. xiii of this Journal, page 120, and on which a patent was obtained for further improvements, on the 9th day of January, 1838. A clear idea could not be given of the present improvements, excepting to a person well acquainted with the machine as formerly constructed; but the following extracts from the specification will afford some general idea of their object.

"My first improvement consists in a gauge for setting the irons when they are to be replaced after being removed, for the purpose of sharpening, by means of which gauge they are at once set to the proper rake and rankness, so as to require little, or no, further adjustment." "My second improvement is in the manner of constructing the sliding frame which governs the grooving saw." "I claim first the construction and use of the gauge for adjusting, or setting, to the proper rake and rankness, the cutting, or plane, irons; the same being made as described. Secondly, I claim the combining with the original sliding frame of the grooving saw of my planing machine, the adjusting frame, screw, and nuts, in the manner, and for the purpose set forth."

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28. For a *Log Brace for Saw Mills*; Benjamin Cushwa, Clear Spring, Washington county, Maryland, July 15.

"My log brace consists of a shaft supported on gudgeons, and crossing the floor of the mill beneath the carriage, at a short distance in front of the saw, said shaft having standards mortised into it, which support a friction roller, intended to sustain the log whilst being sawed. From this shaft there also extends an arm, by which the shaft and roller are held in place, and which arm is raised, and the roller lowered, as the rear end of the log approaches the saw."

"What I claim as constituting my invention in the within described improvement in saw mills, is the manner of using the shaft, carrying the friction roller for supporting logs on saw mills; the several parts connected therewith being combined together, and operating, in combination with the carriage."

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29. For improvements in the *Universal Chuck for Lathes*; Simon Fairman, Waterford, Saratoga county, New York, July 18.

This universal chuck is of the kind in which the holders, or pieces, which confine the articles to be turned, are moved simultaneously towards, or from, the centre of the chuck, by means of a convolute groove on a plate at the back. The first improvement is in the mode of uniting the front and back plates by means of a tube which projects from the back of the front plate, and unites it to the back plate,



the two being held together by a nut which screws on to the end of the tube. The inside of the tube is provided with a female screw to screw on to the mandrel. Whilst the chuck is on the mandrel the nut may be loosened, which will allow of the revolving of the back plate, on which is the convolute groove, to work the holders. The second improvement is in making openings in the outer rim attached to the front plate, through which that part of the holders, which slides in the plate, may pass, so that that part of the holders may be made long for a steady bearing, and be allowed to pass out through those holes in the rim, when any thing of great diameter is to be turned. The following is the claim. "I do not claim to be the inventor of the above described mode of working the holders by means of the convolute groove; but what I do claim as my invention, and desire to secure by letters patent, is the method of securing together the front and back plates, by means of the tube and nut, by which I am enabled to attach the front plate directly to the mandrel, or face plate, of the latter, all as above described. In like manner, I do not claim as my invention, the rim on the front plate, but what I do claim as my invention, is providing the rim with apertures, through which the slides, or holders, can pass, for the purpose, and in the manner above described."

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30. For an improvement in the *Parlour Grate, or Open Fire-Place*; Charles R. Wheeler, Boston, Massachusetts, July 18.

In this grate the jambs are made hollow, and divided into two flues, in order to cause the draught to ascend in one division, and to descend in the other; a cylinder, which runs from bottom to top, constitutes a part of the partition, and through this the air of the room circulates, and becomes heated. The claim is to "the construction of the hollow jambs, by making each of them with a vertical division plate, so as to conduct the smoke down on one side, and up on the other, in combination with the cylinders placed between said flues, for the purpose of heating the air of the room, as described."

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31. For improvements in the manner of *Constructing Kitchen Ranges*; Ebenezer Barrows, Rochester, Massachusetts, July 18.

The fire-chamber of this range consists of a cast iron cylinder placed within the square chamber generally employed in kitchen ranges—on each side of the fire-chamber there is an oven, the side plates of which are provided with an opening, to allow the heat to be radiated through this opening directly into the ovens, as the flues do not pass around them.

The claim is to the "manner of constructing and combining the three compartments constituting the fire-chamber and the side ovens, there being a free opening for the radiation of heat from the fire-cylinder contained in the former, into said side ovens, the latter being without flues around their sides, and their ends being formed of brick."

32. For improvements in the machine for *Cutting Match Splints*; John H. Stevens, Assignee of Elisha Fitzgerald, New York City, July 18.

This machine consists of a horizontally sliding gate, operated by a crank and connecting rod, and this is provided with a number of gauge teeth attached to a plate at one end, and a knife attached to it diagonally, extending from end to end. Above the knife-gate there is a box, in which the block, to be cut into splints, is placed, said box being provided with the necessary apparatus for holding, and for feeding, the block as the splints are cut off. At each stroke of the gate the gauge teeth pass under the block, and divide it into widths equal to the width of a match splint, and the knife then follows with an oblique draw cut, and takes off a plate as thick as the match splints. Each plate, thus cut off, having been previously divided and cut by the "gauge teeth"—the splints are thus completed. The claim is as follows:

"I do not claim as my invention any of the parts of the aforesaid machine, separately, and independently of their combination in said machine; nor do I claim as my invention, or improvement, any of the combinations in the above machine other than such as I have above specially named and claimed. But I do claim as my invention and improvement, the knife, having a diagonal drawing stroke, in combination with the points used as gauge teeth in cutting off and separating match splints by one operation, as described."

33. For a *Machine for Planting Cotton Seeds*; Levin Miner, and Nicholas Felts, Yanceyville, Caswell county, North Carolina, July 18.

In this machine the planting is effected by a wheel placed on the axis of that on which the machine is sustained; the planting wheel has teeth on its periphery, which draw down the seeds from the hopper. The hopper consists of three parts, viz., a board, or piece of wood, having a square hole through it, and which is fixed to the beam directly over the planting wheel; the second part consists of a leather spout, the lower end of which is attached to the above named board, around the square hole; and the third part is in the usual form of a hopper, and is attached to the upper part of the leather spout. This third part is suspended by two cords from two springs to allow it to have a swinging motion, by which to prevent the seeds from adhering to the sides. The back part of the beam to which the coverers, and rake, &c. are attached, is connected to the other part of the beam by a joint behind the sowing beam. The handles are jointed to the forward part of the beam, and also to the back part.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of the hopper, as before described, and the mode of supporting it, in combination therewith; and in forming the beam with a movable joint, to allow of the coverers and rake adapting themselves to inequalities of surface, and also in the

mode of attaching the handles to the movable and fixed parts of the beam, as described."

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34. For an improved mode of *Extracting the Alkaline Properties of the Ashes of Wood in the Manufacture of Pot and Pearlashes*; Jacob Osborn, Elyrica, Lorrain county, Ohio, July 18.

The claim on which this patent was granted, is as follows. "What I claim as my invention, and desire to secure by letters patent, is the addition and application of alum with lime and salt, in such proportions as will extract the whole of the alkaline properties of the ashes, and operate as a cleanser of the article produced." If the patentee would have the goodness to omit the alum and the salt, and employ the lime alone, we will venture to assure him that he would manufacture a more pure article; but then, it is true, he would not exercise the exclusive right to adulterate the alkali in his own way.

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35. For an improvement in *Cooking Stoves*; Lester Tilden, Barre, Washington county, Vermont, July 18.

The body of this stove is made for three boiler holes, one directly over the fire, and one at each end. The back plate is made in a triple curve, so as to concentrate the heat more perfectly around the boilers in the passage of the draught to the flues; from each of these curves a flue runs back to conduct the draught to three vertical pipes which communicate with the flue around the elevated oven, from whence it is taken by a pipe into the chimney. The vertical pipes are each provided with a damper, so that by closing, and opening them, or some of them, the heat can be divided, or concentrated, at pleasure.

Claim.—"Having thus fully described the manner in which I construct my cooking stove, what I claim therein as constituting my invention, and desire to secure by letters patent, is the triple curved form given to the back plate thereof, for the purpose of concentrating the heat upon the boilers, in combination with the elevated oven, and with the separate flues leading from the three compartments of the body of the stove to the three pipes which connect them with the oven flues."

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36. For a *Platform Balance*; Albert Dole, Bangor, Maine, July 18.

The levers in this balance are so arranged that instead of being suspended from the steelyard, and the weight on the balance pulling down, it pushes up, and the bearing is between the fulcrum and the weight; this is effected by having the platform rest on bearings, on the levers, outside the fulcra. Claim.—"What I claim as my invention and improvement, and which I desire to secure by letters patent, is constructing the levers with bearing points beyond their centres, or fulcrums, (fulcra,) for the feet of the platform to rest upon, and placing upon the end of the long lever a vertical rod, extending to the beam above, and upon which it rests, the whole as described."



What is the benefit derived from simply reversing the action of a part of the balance, in the manner described, is not very apparent, and the patentee has not pointed it out.

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37. For *Lottery Schemes*; Joseph Vannini, City of New York, July 18.

Whether lottery schemes belong truly to the class of *useful inventions*, may admit of doubt. That before us is somewhat intricate, is not very clearly set forth, and we should gratify but few of our readers by an attempt to analyze and display it; on our own part we should consider the time very unprofitably occupied, and shall, therefore, think that we have done enough in giving the claim.

"What I claim as my invention, and desire to secure by letters patent, is the mode herein described, of forming lottery schemes by making tickets with a series of ternary and binary combinations, with extra numbers on each ticket, and diminishing the number of tickets in every lottery, and regulating the drawing, in the manner set forth."

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38. For an improved *Mill Bush*; Jacob Aulabaugh, East Berlin, Adams county, Pennsylvania, July 18.

Several patents have been granted for mill bushes, very similar to that before us; the bush is made in sections, and is forced, and kept tight, against the spindle, by means of weighted wedges. The casing which contains the bush and wedges, is filled with oil, to lubricate the spindle; and the oil is prevented from running out of the holes, through which the rods pass that form the connexion between the weights and the wedges, in the following manner, viz. A shoulder, or flanch, projects from the upper back edge of each wedge, to which a rod is attached that passes through a hole made in a "stem," on which the back of the wedge slides; it being grooved out for that purpose. The lower end of each rod is attached to a weighted lever.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of preventing the escape of the oil at the apertures through which passes the connexion between the weight and wedge, by the combination of the rod attached to the weight, the hollow stem, and the opening in the wedge into which the hollow stem fits, as herein described."

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39. For an improvement in *Hydrants and Fire Plugs*; S. H. Davis, Cincinnati, Ohio, July 18.

The valve seat of this hydrant is attached to the lower end of a copper tube, through which the water is to be discharged, and its lower end screws on to the street pipe. The valve is attached to the lower end of a rod, and is closed by being drawn up against its seat. The valve rod passes through the upper end of the copper tube, and is surrounded by a spiral spring, which acts against a shoulder at the upper end of the rod and the top of the tube, and the tension of the spring keeps the valve closed. Above the valve seat there is a ring

attached to the sides of the chamber by means of arms, allowing the water to pass between the outside of the ring and the inside of the tube—the valve rod passing through its centre. The valve rod is provided with a collar faced with leather on the under side, a little above this ring, and the ring has a hole made in its upper surface, which passes through one of its arms, and through the tube. When the valve rod is pressed down, the leather on the collar closes the hole in the ring, and opens the valve, which allows the water to flow up, and out of the pipe, but when it is liberated, the tension of the spring closes the valve, which stops the flow of water, and opens the hole in the ring, through which the water in the tube is discharged, to prevent freezing.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is placing the valve seats in a separate chamber, which is adapted to, and made to screw on a chamber connected with, and opening into the main pipes, and fitting to the valve seats in said chamber, valves placed on a vertical stem passing through a tube connected with the upper part of the chamber, said stem being operated by springs, in the manner, and for the purpose herein set forth.”

40. For an improvement in the *Spindle and Trundle Head of Mills*; Eldridge G. Potter, Lebanon, St. Clair county, Illinois, July 18.

The proposed improvement is for forming the connexion between a trundle head and its spindle, to prevent the “backlash.” Instead of having the trundle head fixed to, it turns freely on the spindle, and is provided with arms, that act against springs attached to the spindle, and by this connexion the spindle is put in motion. The claim is confined to this device.

41. For an improvement in the *Thumb Latch*; Philos, Eli W., and John A. Blake, New Haven, Connecticut, July 21.

This patent was granted for some modifications of the thumb latch, which, although but slight, will be important to the manufacturer. As the claims could not be understood without a full description of the modifications, which would require drawings to illustrate them, they are omitted. The improvements consist of a peculiar manner of arranging the thumb lever, so as to dispense with the fulcrum pin, and in the formation of some of the other parts of the latch, by which they can be cast more perfectly, and with greater facility than heretofore.

42. For *Machinery to be Employed in Turning Various Articles*; John Clark, Jr., Glasgow, North Britain, July 30.

A number of mandrels are ranged around a circle, with their axes parallel to each other; to each of them a rotary motion on their own axes is communicated, and they, at the same time, are made to travel around the centre of the circle, around which they are ranged. The articles to be turned, or shaped, are properly attached to these man-

drels, and as they travel round they come in contact with rotary, or permanent, cutters, rasps, &c., properly arranged within and without the circle; or the mandrels may be ranged in a straight line, and whilst they have a rapid rotary motion on their own axis, they, at the same time, traverse in a straight line, and are thus brought in contact with a series of rotary cutters, &c. &c., arranged in a straight line. The claim is to "the combination of machinery, whereby a number of articles to be turned are arranged parallel to one another, in a circle, or straight line, and made to pass by a series of rotary, or stationary, cutters, grinders, &c.

43. For a *Smut Machine*; Hiram Smith, Bethany, Genessee county, New York, July 31.

This machine consists of a vertical cylinder with beaters thereon, ranged around in sets. These beaters revolve in a cylindrical casing, which is provided with ledges, or flanches, running around in the direction of the diameter, one between each set of beaters; the casing is furnished towards its upper and lower ends with vertical apertures similar to those of venetian blinds. The inner surface of the casing and the ledges are rough. The grain is fed in at the top, and discharged at the bottom. Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the mode of constructing the cylinder by forming it with circular ledges and oblique apertures, in combination with the revolving beaters, constructed, and operating in the manner set forth."

44. For improvements in the *Mariner's and Surveyor's Compass*; William C. Poole, Lancaster, Pennsylvania, July 31.

The patentee says—"The nature of my invention consists in a fixture, to be attached to either a surveyor's, or mariner's, compass, by means of which the absolute variation may be ascertained by the meridian sun. This fixture is provided with reflectors, one movable, placed at right angles with the sights of the compass, and the other, stationary, attached to one of the sight vanes, in which an observer may, by the action of the moving reflector, see the sun at meridian."

"What I claim as my invention and discovery, and desire to secure by letters patent, is the method herein described of obtaining the meridian line, and thereby ascertaining the variation of the needle, by means of a compass constructed with a fixed and movable reflector."

45. For a *Balance, or Scale Beam*; Seth E. Winslow, Philadelphia, Pennsylvania, July 31.

A peculiar manner of making the fulcrum of a scale beam is the subject of this patent. Instead of having the fulcrum, on which the beam rests, separate from those of the shackle, to which the articles to be weighed are suspended, the two sets are made of one piece of metal, and may be brought very near together. A piece of metal of the requisite size for the axis of the beam is taken, and its lower side is



reduced to an edge; this edge is then rolled, or turned up, at an angle of 180°. A portion is then cut away from each of the ends, which are formed so as to constitute the usual knife edge bearings, or fulcra. The shackles are made with holes of sufficient size, and of the necessary form, to pass over the body of the axle on each side of the beam, and rest upon the turned up edge, and that part of each end which is formed in the usual way, projects beyond the shackle, and rests in the holes of the suspending shackle. The claim is confined to the "construction of the single axle with double fulcra, as described."

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46. For *Making, Ruling, and Cutting Paper*; John Ames, Springfield, Massachusetts, July 31.

In this machine the ruling machine is combined with the cutting and drying part of a paper making machine, in such manner that as the paper leaves the drying cylinder it is conducted to a roller with a set of pens, which rules it on one side, and thence to another, which rules it on the opposite side, whence it passes to the machine, which cuts it into sheets. The second ruling machine has a cam, which lifts the pen at certain regulated distances, for the purpose of ruling letter paper, which is ruled on three sides only. Claim.—"What I claim is the combining of the ruling and cutting machines with the drying cylinder, from which drying cylinder the paper is delivered in an endless sheet; said combination being made substantially in the manner herein set forth; the paper, when required, being successively ruled on both sides, by means of two ruling cylinders and their appendages, in the manner described, and being conducted from the last cylinder to the cutting machine, also as described.

I likewise claim, in combination with the ruling and cutting apparatus, the manner of raising the pens on the second ruling cylinder, by means of the cam and its appurtenances, so as to leave the required portion of the paper unruled."

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47. For improvements in *Portable Baths*; J. Wright Warren, Jr., Boston, Massachusetts, July 31.

The patentee says—"The object of my invention is to combine in one arrangement all the conveniences for taking all the several descriptions of baths, such as warm, cold, vapour, medicated vapour, and shower baths, said arrangement being constructed with due regard to simplicity and portability."

The apparatus is arranged like a couch, the box for containing the water being provided with a hinged cover. This cover is pierced with holes, for taking the vapour baths. The apparatus for generating the vapour, whether medicated or not, is separate from the other parts, the vapour being admitted through suitable pipes. The apparatus for the shower bath is suspended from the upper part of the machine; it would be useless to give the claims, as they refer throughout, to the drawings.

## SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for an Improvement in the Process of Manufacturing Fair Leather. Granted to JOHN L. TURNER, of Philadelphia, Pennsylvania, July 15th, 1840.*

To all whom it may concern: Be it known that I, John L. Turner, of the City of Philadelphia, State of Pennsylvania, have invented, or discovered, an improvement in the process for manufacturing that kind of leather which is technically denominated *fair leather*, and which is used by saddlers, coach makers, book binders, and others, for various purposes in the useful arts; and I do hereby declare that the following is a full and exact description of my said improved process, for the purpose of giving to fair leather that light appearance, and that particular colour, which is required in its various applications. I take it in that part of the process of manufacturing it subsequent to its having been thoroughly scoured, set out, and stuffed, preparatory to the process of drying, and in this state I take sulphuric ether, and with a brush, or other suitable article, I wash, or spread over, this fluid, on the face of the leather which is to be whitened. Before performing this operation, I prepare a mixture of tallow and spirits of turpentine, incorporated in such proportion as to have the consistence of thick oil; and with this I immediately, in like manner, pay over, or cover, the surface of the leather, which is then ready to be dried in the usual manner.

By the action of the sulphuric ether, the required whiteness, or fair appearance, is given to the leather, but if it is dried after the application of the ether, without that of the tallow and spirits of turpentine, or of some analogous softening material, there will be a degree of harshness, and want of pliability, produced upon the surface, which is objectionable, and which, by the means prescribed, is entirely removed. Having thus fully described the nature of my improvement in the process of manufacturing what is known under the denomination of fair leather, and shown the manner in which I carry the same into effect, what I claim therein as constituting my invention, or discovery, is the employment of sulphuric ether, to produce the required light, or fair appearance, in such leather, in the manner, and under the conditions, substantially as herein set forth.

It is highly probable that some other of the etherial fluids, such, for example, as nitric, or muriatic ether, would produce an effect similar to that produced by sulphuric ether, but as the latter is perfectly effectual in its operation, and can be most economically obtained, I have not thought it necessary to essay the other kinds, but I do hereby declare that I do not intend to limit my claim to the use of sulphuric ether alone, but that I embrace therein, and intend to use, any of the fluids properly denominated ether.

JOHN L. TURNER.

*Remarks by the Editor.*—We give the foregoing specification not

because we think the *invention* one of great importance. When this patent was issued we were entirely at a fault in endeavouring to discover the rationale of the process; and we have been subsequently informed by a respectable and intelligent manufacturer, who has essayed it, that the intended effect is not produced by the means set forth. If this is the fact, and the patentee has not told "the whole truth," he has not fulfilled the requirements of the law, and his patent is a nullity.

### SPECIFICATIONS OF ENGLISH PATENTS.

*Specification of a Patent Granted to GERARD RALSTON, of the City of London, for Improvements in Rolling Puddle Balls, or other masses of Iron,—being a Communication.* [Sealed 22nd of February, 1840.]

These improvements in rolling paddle balls, or other masses of iron, consist in the employment of a peculiar construction of machine, for the purpose of compressing, and rolling out, red hot balls, or masses of puddle iron, into that state commonly called bloom, preparatory to the mass being rolled down into bars, or plates, or operated upon by tilt hammers.

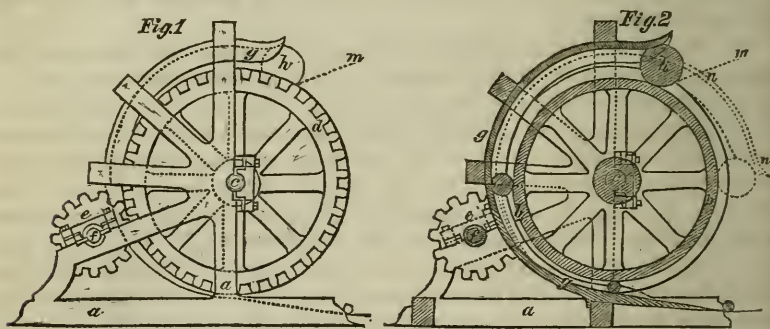


Figure 1 represents a side elevation of the machine; and fig. 2 is a section taken vertically through the rolling cylinder. *a, a, a,* is the framework supporting the machinery, which framework may be of cast iron, or any other suitable material. *b, b,* is the rolling cylinder, turning upon an axle *c, c,* supported by the side frames; and *d, d,* are toothed wheels, affixed to the ends of the cylinder. *e,* is one of two pinions, or small wheels, upon a shaft *f,* also mounted upon the framework; which pinions, or wheels, being driven by any convenient power, and taking into the teeth of the wheels *d, d,* cause the cylinder *b,* to revolve.

A segmental piece of iron, *g, g,* is firmly fixed to the framework,



partially embracing the cylinder *b, b*; but in an eccentric position to the periphery of the cylinder, as shown in the section, fig. 2. Between this segment piece, and the cylinder, the ball, or mass of red hot puddle iron *h*, is passed, for the purpose of rolling and compressing it.

The large ball, or mass of iron, having been prepared in the puddling furnace in the ordinary way, it is to be introduced into the machine, as shown at *h*. Rotary motion being given to the cylinder as described, the mass of iron will be carried forward between the cylinder *b*, and the segment piece *g*, by which it will be gradually compressed and reduced in its diameter, increasing in length until it is ultimately delivered out at bottom in the form of a roll, or long cylindrical piece, ready to be taken to the tilt hammers to be drawn out, or to the ordinary rollers, where it may be rolled into a bar, or sheet.

It may be here remarked, that the mouth of the segment piece *g*, should be made nearly simicircular, which form it partially retains for the purpose of compressing the mass on all sides during one or two rotations of the ball; but that its groove thence gradually widens out towards the end; which form is for the purpose of confining, or upsetting the ends of the mass of iron under operation.

The patentee claims, first:—The entire machine, as above arranged, for rolling, or shaping, puddle balls, or other masses of iron, preparatory to being rolled, or even drawn into a bar by the hammer; but he states, the outside casing might be brought farther down in front of the machine, as represented by the dotted line *n, n*, fig. 2; which arrangement improves its operation, giving a greater number of revolutions to the ball,—consequently reducing it more gradually.

Secondly:—He claims the plan of laying the above named machine in a horizontal position, when found better adapted to the situation where it is placed, and so altering it as to permit the upper flanch, or edge, of the segment piece, to rise and fall, to admit of a larger or smaller ball. The weight of the said flanch being so proportioned as to upset the ends of the ball, or bloom, sufficiently.

The same effect may be also produced by a cylinder, revolving within a stationary curved casing, as above described; or by a straight plate of iron, held stationary, in lieu of the above-described casing; while another, shaped like a wedge, is confined at a suitable distance apart, and moved by a crank; thus rolling a ball into a bloom each revolution of the said crank, the principle being one and the same.

Lond. Jour. Arts and Sciences.

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*Specification of a Patent Granted to PIERRE ARMAND LE COMITE DE FONTAINEMOREAU, of Skinner's Place, Sizelane, for Certain Improvements in Covering and Coating Metals and Alloys of Metals. February 15th, 1841.*

These improvements relate to an improved mode of covering or coating certain metals or alloys of metals, with gold, silver, or platinum.

Firstly, of gold; this process is particularly applicable to coating or covering copper and its alloys, to silver and its alloys, and to some other alloys more or less alloyed with copper; to iron, tin, bismuth, antimony, and to the several alloys of these metals.

In all cases, the first operation consists in preparing or cleansing the article to be coated, or covered, after the workman has given it the precise form which it is to retain; for this purpose it is heated to redness, and when moderately cooled, it is to be quenched in water slightly acidulated with sulphuric acid. A bath is prepared by adding one part (by weight,) of sulphuric acid to one part of water and two parts of azotic acid, into which the goods are to be placed. When the articles begin to turn black, they are to be taken out of this bath, and thrown into azotic acid of thirty to thirty-six degrees of Beaume's areometer, when they will become of a fine bright yellow colour, and are to be washed in fair water and scratch-brushed. The work is then to be burnished in such parts as are to be finished in that way. Silver articles are to be cleaned by heating them, and then throwing them into acidulated water, and letting them remain for three or four hours, or until they become white, when they are to be taken out and scoured with water and fine sand.

A solution of gold is prepared by dissolving pure gold in a finely divided state in brome or chlorine, or in some azote chlorohydric acid, or in some azote iodydric acid; this solution is evaporated to the consistence of sirop.

The operation may then be conducted by any one of the following five methods, which constitute five different modes of gilding, the first being preferred.

**First Bath.**—Four hundred parts (by weight,) of distilled water are to be placed in an enamelled iron pot, and made tepid, when seventy parts hydrated oxide of barium, hydrate of barytes, or seventy parts hydrated oxide of strontium, hydrate strontites, are added. When these are dissolved, the gold solution is added, and the whole boiled together; as soon as the mixture begins to turn purple, the articles of copper, or its alloys, are to be immersed therein. On being taken out they are first dipped in acidulated water, afterwards in fair water, scratch-brushed, and dried off in sawdust. If silver articles are to be gilded, they must be covered with copper wire, otherwise they will not take the gold.

**Second Bath.**—Common water is to be used instead of the distilled water, with forty-five parts, by weight, of oxide of lithin, to which the solution of gold is to be added, and the operation conducted as before.

**Third Bath.**—Three parts of gold prepared as before, 1,000 parts water, 125 parts quicklime, or seventy-five parts of magnesia, besides twenty-five parts chlorine of calcium, or chlorine of magnesia, are boiled together, and used as before.

**Fourth Bath.**—Eight parts of gold in solution, fifty to eighty parts of oxide of zinc, 100 parts of water, and 350 parts chlorine of zinc, boiled, &c., as before.

**Fifth Bath.**—Five parts of gold precipitated by oxide of zinc, 500

parts distilled water, 250 parts chlorine of barium, or strontium, zinc, lime, or magnesia, boiled, &c. as before.

Secondly, for coating, or covering, articles with silver. Ten parts of silver are dissolved in azotic acid, evaporated to dryness, and then re-dissolved in distilled water. Into an enameled iron pot put 5000 parts of water, 900 parts of chloride of barium, or of strontium, of lime, magnesia, or zinc; to these add from 1000 to 1400 parts of cream of tartar, and boil the mixture; then add the silver solution, with twenty-five parts boric acid. The articles to be silvered are to be plunged in, and when the coating is strong enough, taken out, washed in tepid water, scratch-brushed and dried.

Thirdly, for coating and covering metals with platinum, a solution of two parts of platinum in azotic acid, chlorohydric, or boric acids; when evaporated nearly to dryness add forty parts of distilled water, fifteen parts chloride of barium, or of strontium, lime, magnesia, or zinc, or chloride of ammonia, and boil them together. The articles are to be immersed till they take a grey coat, they are then to be thrown into water, well washed, scratch-brushed, and dried.

The claim is, 1. The use of the substances named in the first mentioned process, for coating and covering metals and alloys with gold, as well as all the salts of their bases, either alone or combined with other substances; the substances being barytes, strontites, lithin, lime, magnesia, and their salts.

2. In the process for coating and covering with silver, the chlorines of barium, barytes of sodium, of strontium, strontites of lime, of magnesia, and of zinc, either alone, or mixed with other substances; and the mode of operating with them.

3. In the process of coating and covering with platinum, the use of double chlorines of platinum and of barium, barytes of strontium, strontites of magnesia, lime, ammonia, and zinc, alone, or combined. Also the oxides and salts of these bases, either alone or combined with the salts, or oxides, of platinum.

Mech. Mag.

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*Specification of a Patent granted to JOSEPH LEESE, JR., of Manchester, for Certain Improvements in Printing Calicoes and other Surfaces. December 24, 1840.*

The first of these improvements refers to the employment of a peculiarly formed fabric instead of the blanket usually employed in calico printing. This is composed of several layers of calico or other suitable fabrics, coated and cemented together with a solution of India rubber; the ends being joined, an improved endless fabric is formed, having the necessary elasticity in its thickness, but non-elastic in its length and breadth.

The second improvement relates to what is technically called "rain-bowing," which is performed in the following manner; a number of sieves containing the different shades of colour are placed nearly under each other; over each sieve a disk revolves, having projections of copper wire, or other suitable material, which dip into the colours. These



disks are supported on pedestals which admit of easy adjustment, and are so regulated, that as they revolve, the projecting wires give colour to the cylinder in successively lighter shades, which are imprinted on the fabric under operation.

A third improvement relates to printing blocks, which are to be covered with a surface of India rubber, through which the pattern is to be cut, its sides being supported by a thin metal edging. This arrangement will, it is said, greatly increase the durability of the block, while the pattern will be much better printed on the calico, &c.

Ibid.

| LUNAR OCCULTATIONS FOR PHILADELPHIA,<br>OCTOBER, 1841.<br>COMPUTED BY JOHN DOWNES. |      |      |              |              |      | Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.<br>☞ For direct vision add 180°. |                     |
|------------------------------------------------------------------------------------|------|------|--------------|--------------|------|--------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Day.                                                                               | H'r. | Min. | Star's name. |              | Mag. | From Moon's North point.                                                                                                       | From Moon's Vertex. |
| 1                                                                                  | 7    | 35   | Im.          | 101 Piscium, | 6    | 157°                                                                                                                           | 104°                |
| 1                                                                                  | 8    | 24   | Em.          |              |      | 264                                                                                                                            | 212                 |
| 6                                                                                  | 15   | 47   | Im.          | ε Geminorum, | 6    | 44                                                                                                                             | 253                 |
| 6                                                                                  | 16   | 32   | Em.          |              |      | 321                                                                                                                            | 298                 |
| 31                                                                                 | 16   | 28   | Im.          | χ Tauri,     | 6    | 102                                                                                                                            | 159                 |
| 31                                                                                 | 17   | 39   | Em.          |              |      | 261                                                                                                                            | 319                 |

### Meteorological Observations for July, 1841.

| Moon.                            | Days | Therm.    |        | Barometer. |              | Wind.     |                    | Water fallen in rain. | State of the weather, and Remarks. |
|----------------------------------|------|-----------|--------|------------|--------------|-----------|--------------------|-----------------------|------------------------------------|
|                                  |      | Sun rise. | 2 P.M. | Sun rise.  | 2 P.M.       | Direction | Force.             |                       |                                    |
|                                  |      |           |        | Inch's     | Inch's       |           |                    | Inches.               |                                    |
|                                  | 1    | 72        | 88     | 29.85      | 29.80        | W.        | Moderate.          |                       | Partially cloudy—clear.            |
|                                  | 2    | 72        | 81     | .80        | .85          | W.        | do.                |                       | Cloudy—clear.                      |
| ☉                                | 3    | 60        | 77     | .90        | .90          | E.        | do.                |                       | Clear—do.                          |
|                                  | 4    | 56        | 79     | .92        | .92          | N.        | do.                |                       | Clear—do.                          |
|                                  | 5    | 61        | 84     | .86        | .80          | W.        | Brisk.             | .34                   | Partially cloudy—clear—rain.       |
|                                  | 6    | 64        | 82     | .75        | .75          | W.        | Moderate.          |                       | Cloudy—clear.                      |
|                                  | 7    | 70        | 79     | .75        | .80          | W.        | do.                |                       | Lightly cloudy—do.—do.             |
|                                  | 8    | 62        | 80     | .80        | .90          | W.        | do.                | .30                   | Cloudy—clear.                      |
|                                  | 9    | 62        | 80     | .96        | .95          | W.        | do.                |                       | Clear—clear.                       |
|                                  | 10   | 69        | 80     | .79        | .79          | NW.       | do.                |                       | Cloudy—clear.                      |
| ☾                                | 11   | 60        | 75     | .87        | .84          | NW.       | do.                |                       | Clear—clear.                       |
|                                  | 12   | 59        | 77     | .80        | .78          | W.        | do.                |                       | Flying clouds—clear.               |
|                                  | 13   | 64        | 81     | .76        | .76          | W.        | do.                |                       | Lightly cloudy—do.—do.             |
|                                  | 14   | 70        | 85     | .76        | .77          | W.        | Brisk.             | .35                   | Cloudy—clear—rain.                 |
|                                  | 15   | 70        | 85     | .77        | .77          | W.        | Moderate.          |                       | Partially cloudy—do.—do.           |
|                                  | 16   | 70        | 89     | .77        | .77          | E W.      | do.                |                       | Clear—do.                          |
|                                  | 17   | 62        | 78     | .93        | .94          | W.        | Brisk.             |                       | Clear—do.                          |
| ☼                                | 18   | 62        | 83     | .94        | .94          | S. SW.    | Moderate.          |                       | Clear—do.                          |
|                                  | 19   | 62        | 84     | .93        | .96          | S. SW.    | do.                |                       | Clear—do.                          |
|                                  | 20   | 66        | 87     | 30.07      | 30.08        | SW        | do.                |                       | Clear—do.                          |
|                                  | 21   | 61        | 85     | .23        | .08          | SE.       | do.                |                       | Clear—lightly cloudy.              |
|                                  | 22   | 70        | 84     | .12        | .05          | SW.       | do.                |                       | Cloudy—partially cloudy.           |
|                                  | 23   | 70        | 88     | 29.96      | 29.96        | SW.       | do.                |                       | Clear—clear.                       |
|                                  | 24   | 72        | 90     | .93        | .94          | SW.       | do.                | .17                   | Clear—lightly cloudy.              |
| ☾                                | 25   | 76        | 94     | .89        | .82          | W. SW.    | Calm.              |                       | Cloudy—par. cloudy—rain in night.  |
|                                  | 26   | 70        | 79     | .83        | .91          | NW.       | Brisk.             |                       | Clear—clear.                       |
|                                  | 27   | 60        | 79     | .99        | .66          | NE.       | Moderate.          |                       | Clear—cloudy.                      |
|                                  | 28   | 63        | 82     | .98        | .85          | NE.       | do.                |                       | Lightly cloudy—do.—do.             |
|                                  | 29   | 53        | 77     | 30.00      | 30.00        | NE.       | do.                |                       | Clear—do.                          |
|                                  | 30   | 64        | 73     | 29.90      | 29.90        | NE.       | do.                |                       | Partially cloudy—cloudy.           |
|                                  | 31   | 66        | 65     | .70        | .70          | E.        | do.                | 1.75                  | Rain—do.                           |
|                                  | Mean | 65.45     | 81.48  | 29.89      | 29.87        |           |                    | 2.91                  |                                    |
| Thermometer.                     |      |           |        |            |              |           |                    |                       |                                    |
| Maximum height during the month, |      |           |        | 94.00      | on the 25th. |           | Barometer.         |                       |                                    |
| Minimum                          |      |           |        | 56.00      | “ 4th.       |           | 30.23 on the 21st. |                       |                                    |
| Mean                             |      |           |        | 73.47      |              |           | 29.66 “ 27th.      |                       |                                    |
|                                  |      |           |        |            |              |           | 29.88              |                       |                                    |

FOR THE STATE OF PENNSYLVANIA,  
 collated from returns made to the Committee on Meteor-  
 ology of the Franklin Institute of the State of Pennsylv-  
 ania, for

MARCH, 1841.

## Register.

|               |  |
|---------------|--|
| 7, A. M.      |  |
| 2, P. M.      |  |
| 9, P. M.      |  |
| Maximum.      |  |
| Minimum.      |  |
| Mean.         |  |
| Days omitted. |  |
| Lowest.       |  |
| Mean.         |  |
| Days omitted. |  |

**Weather.**

|                  |
|------------------|
| 7, A. M.         |
| 2, P. M.         |
| 9, P. M.         |
| Maximum.         |
| Minimum          |
| Mean.            |
| Days omitted.    |
| Clear.           |
| Cloudy.          |
| Days omitted.    |
| Rain.            |
| Snow.            |
| Rain and Snow.   |
| Thunder Showers. |
| Rain in inches.  |

### Hygrometer.

|        |          |       |          |       |          |       |          |        |          |       |          |       |          |       |          |       |               |            |               |                            |           |               |                |
|--------|----------|-------|----------|-------|----------|-------|----------|--------|----------|-------|----------|-------|----------|-------|----------|-------|---------------|------------|---------------|----------------------------|-----------|---------------|----------------|
| North. | N. N. E. | N. E. | E. N. E. | East. | E. S. E. | S. E. | S. S. E. | South. | S. S. W. | S. W. | W. S. W. | West. | W. N. W. | N. W. | N. N. W. | Calm. | Days omitted. | Dew-point. | Days omitted. | Inf. therm. and dew-point. | Wet Bulb. | Days omitted. | No. of Report. |
|--------|----------|-------|----------|-------|----------|-------|----------|--------|----------|-------|----------|-------|----------|-------|----------|-------|---------------|------------|---------------|----------------------------|-----------|---------------|----------------|

| County. | Town. | Observer. | 1890. |  |  |  |  |  |  |  |  |  | 1891. |  |  |  |  |  |  |  |  |  | 1892. |  |  |  |  |  |  |  |  |  | 1893. |  |  |  |  |  |  |  |  |  | 1894. |  |  |  |  |  |  |  |  |  | 1895. |  |  |  |  |  |  |  |  |  | 1896. |  |  |  |  |  |  |  |  |  | 1897. |  |  |  |  |  |  |  |  |  | 1898. |  |  |  |  |  |  |  |  |  | 1899. |  |  |  |  |  |  |  |  |  | 1900. |  |  |  |  |  |  |  |  |  | 1901. |  |  |  |  |  |  |  |  |  | 1902. |  |  |  |  |  |  |  |  |  | 1903. |  |  |  |  |  |  |  |  |  | 1904. |  |  |  |  |  |  |  |  |  | 1905. |  |  |  |  |  |  |  |  |  | 1906. |  |  |  |  |  |  |  |  |  | 1907. |  |  |  |  |  |  |  |  |  | 1908. |  |  |  |  |  |  |  |  |  | 1909. |  |  |  |  |  |  |  |  |  | 1910. |  |  |  |  |  |  |  |  |  | 1911. |  |  |  |  |  |  |  |  |  | 1912. |  |  |  |  |  |  |  |  |  | 1913. |  |  |  |  |  |  |  |  |  | 1914. |  |  |  |  |  |  |  |  |  | 1915. |  |  |  |  |  |  |  |  |  | 1916. |  |  |  |  |  |  |  |  |  | 1917. |  |  |  |  |  |  |  |  |  | 1918. |  |  |  |  |  |  |  |  |  | 1919. |  |  |  |  |  |  |  |  |  | 1920. |  |  |  |  |  |  |  |  |  | 1921. |  |  |  |  |  |  |  |  |  | 1922. |  |  |  |  |  |  |  |  |  | 1923. |  |  |  |  |  |  |  |  |  | 1924. |  |  |  |  |  |  |  |  |  | 1925. |  |  |  |  |  |  |  |  |  | 1926. |  |  |  |  |  |  |  |  |  | 1927. |  |  |  |  |  |  |  |  |  | 1928. |  |  |  |  |  |  |  |  |  | 1929. |  |  |  |  |  |  |  |  |  | 1930. |  |  |  |  |  |  |  |  |  | 1931. |  |  |  |  |  |  |  |  |  | 1932. |  |  |  |  |  |  |  |  |  | 1933. |  |  |  |  |  |  |  |  |  | 1934. |  |  |  |  |  |  |  |  |  | 1935. |  |  |  |  |  |  |  |  |  | 1936. |  |  |  |  |  |  |  |  |  | 1937. |  |  |  |  |  |  |  |  |  | 1938. |  |  |  |  |  |  |  |  |  | 1939. |  |  |  |  |  |  |  |  |  | 1940. |  |  |  |  |  |  |  |  |  | 1941. |  |  |  |  |  |  |  |  |  | 1942. |  |  |  |  |  |  |  |  |  | 1943. |  |  |  |  |  |  |  |  |  | 1944. |  |  |  |  |  |  |  |  |  | 1945. |  |  |  |  |  |  |  |  |  | 1946. |  |  |  |  |  |  |  |  |  | 1947. |  |  |  |  |  |  |  |  |  | 1948. |  |  |  |  |  |  |  |  |  | 1949. |  |  |  |  |  |  |  |  |  | 1950. |  |  |  |  |  |  |  |  |  | 1951. |  |  |  |  |  |  |  |  |  | 1952. |  |  |  |  |  |  |  |  |  | 1953. |  |  |  |  |  |  |  |  |  | 1954. |  |  |  |  |  |  |  |  |  | 1955. |  |  |  |  |  |  |  |  |  | 1956. |  |  |  |  |  |  |  |  |  | 1957. |  |  |  |  |  |  |  |  |  | 1958. |  |  |  |  |  |  |  |  |  | 1959. |  |  |  |  |  |  |  |  |  | 1960. |  |  |  |  |  |  |  |  |  | 1961. |  |  |  |  |  |  |  |  |  | 1962. |  |  |  |  |  |  |  |  |  | 1963. |  |  |  |  |  |  |  |  |  | 1964. |  |  |  |  |  |  |  |  |  | 1965. |  |  |  |  |  |  |  |  |  | 1966. |  |  |  |  |  |  |  |  |  | 1967. |  |  |  |  |  |  |  |  |  | 1968. |  |  |  |  |  |  |  |  |  | 1969. |  |  |  |  |  |  |  |  |  | 1970. |  |  |  |  |  |  |  |  |  | 1971. |  |  |  |  |  |  |  |  |  | 1972. |  |  |  |  |  |  |  |  |  | 1973. |  |  |  |  |  |  |  |  |  | 1974. |  |  |  |  |  |  |  |  |  | 1975. |  |  |  |  |  |  |  |  |  | 1976. |  |  |  |  |  |  |  |  |  | 1977. |  |  |  |  |  |  |  |  |  | 1978. |  |  |  |  |  |  |  |  |  | 1979. |  |  |  |  |  |  |  |  |  | 1980. |  |  |  |  |  |  |  |  |  | 1981. |  |  |  |  |  |  |  |  |  | 1982. |  |  |  |  |  |  |  |  |  | 1983. |  |  |  |  |  |  |  |  |  | 1984. |  |  |  |  |  |  |  |  |  | 1985. |  |  |  |  |  |  |  |  |  | 1986. |  |  |  |  |  |  |  |  |  | 1987. |  |  |  |  |  |  |  |  |  | 1988. |  |  |  |  |  |  |  |  |  | 1989. |  |  |  |  |  |  |  |  |  | 1990. |  |  |  |  |  |  |  |  |  | 1991. |  |  |  |  |  |  |  |  |  | 1992. |  |  |  |  |  |  |  |  |  | 1993. |  |  |  |  |  |  |  |  |  | 1994. |  |  |  |  |  |  |  |  |  | 1995. |  |  |  |  |  |  |  |  |  | 1996. |  |  |  |  |  |  |  |  |  | 1997. |  |  |  |  |  |  |  |  |  | 1998. |  |  |  |  |  |  |  |  |  | 1999. |  |  |  |  |  |  |  |  |  | 2000. |  |  |  |  |  |  |  |  |  | 2001. |  |  |  |  |  |  |  |  |  | 2002. |  |  |  |  |  |  |  |  |  | 2003. |  |  |  |  |  |  |  |  |  | 2004. |  |  |  |  |  |  |  |  |  | 2005. |  |  |  |  |  |  |  |  |  | 2006. |  |  |  |  |  |  |  |  |  | 2007. |  |  |  |  |  |  |  |  |  | 2008. |  |  |  |  |  |  |  |  |  | 2009. |  |  |  |  |  |  |  |  |  | 2010. |  |  |  |  |  |  |  |  |  | 2011. |  |  |  |  |  |  |  |  |  | 2012. |  |  |  |  |  |  |  |  |  | 2013. |  |  |  |  |  |  |  |  |  | 2014. |  |  |  |  |  |  |  |  |  | 2015. |  |  |  |  |  |  |  |  |  | 2016. |  |  |  |  |  |  |  |  |  | 2017. |  |  |  |  |  |  |  |  |  | 2018. |  |  |  |  |  |  |  |  |  | 2019. |  |  |  |  |  |  |  |  |  | 2020. |  |  |  |  |  |  |  |  |  | 2021. |  |  |  |  |  |  |  |  |  | 2022. |  |  |  |  |  |  |  |  |  | 2023. |  |  |  |  |  |  |  |  |  | 2024. |  |  |  |  |  |  |  |  |  | 2025. |  |  |  |  |  |  |  |  |  | 2026. |  |  |  |  |  |  |  |  |  | 2027. |  |  |  |  |  |  |  |  |  | 2028. |  |  |  |  |  |  |  |  |  | 2029. |  |  |  |  |  |  |  |  |  | 2030. |  |  |  |  |  |  |  |  |  | 2031. |  |  |  |  |  |  |  |  |  | 2032. |  |  |  |  |  |  |  |  |  | 2033. |  |  |  |  |  |  |  |  |  | 2034. |  |  |  |  |  |  |  |  |  | 2035. |  |  |  |  |  |  |  |  |  | 2036. |  |  |  |  |  |  |  |  |  | 2037. |  |  |  |  |  |  |  |  |  | 2038. |  |  |  |  |  |  |  |  |  | 2039. |  |  |  |  |  |  |  |  |  | 2040. |  |  |  |  |  |  |  |  |  | 2041. |  |  |  |  |  |  |  |  |  | 2042. |  |  |  |  |  |  |  |  |  | 2043. |  |  |  |  |  |  |  |  |  | 2044. |  |  |  |  |  |  |  |  |  | 2045. |  |  |  |  |  |  |  |  |  | 2046. |  |  |  |  |  |  |  |  |  | 2047. |  |  |  |  |  |  |  |  |  | 2048. |  |  |  |  |  |  |  |  |  | 2049. |  |  |  |  |  |  |  |  |  | 2050. |  |  |  |  |  |  |  |  |  | 2051. |  |  |  |  |  |  |  |  |  | 2052. |  |  |  |  |  |  |  |  |  | 2053. |  |  |  |  |  |  |  |  |  | 2054. |  |  |  |  |  |  |  |  |  | 2055. |  |  |  |  |  |  |  |  |  | 2056. |  |  |  |  |  |  |  |  |  | 2057. |  |  |  |  |  |  |  |  |  | 2058. |  |  |  |  |  |  |  |  |  | 2059. |  |  |  |  |  |  |  |  |  | 2060. |  |  |  |  |  |  |  |  |  | 2061. |  |  |  |  |  |  |  |  |  | 2062. |  |  |  |  |  |  |  |  |  | 2063. |  |  |  |  |  |  |  |  |  | 2064. |  |  |  |  |  |  |  |  |  | 2065. |  |  |  |  |  |  |  |  |  | 2066. |  |  |  |  |  |  |  |  |  | 2067. |  |  |  |  |  |  |  |  |  | 2068. |  |  |  |  |  |  |  |  |  | 2069. |  |  |  |  |  |  |  |  |  | 2070. |  |  |  |  |  |  |  |  |  | 2071. |  |  |  |  |  |  |  |  |  | 2072. |  |  |  |  |  |  |  |  |  | 2073. |  |  |  |  |  |  |  |  |  | 2074. |  |  |  |  |  |  |  |  |  | 2075. |  |  |  |  |  |  |  |  |  | 2076. |  |  |  |  |  |  |  |  |  | 2077. |  |  |  |  |  |  |  |  |  | 2078. |  |  |  |  |  |  |  |  |  | 2079. |  |  |  |  |  |  |  |  |  | 2080. |  |  |  |  |  |  |  |  |  | 2081. |  |  |  |  |  |  |  |  |  | 2082. |  |  |  |  |  |  |  |  |  | 2083. |  |  |  |  |  |  |  |  |  | 2084. |  |  |  |  |  |  |  |  |  | 2085. |  |  |  |  |  |  |  |  |  | 2086. |  |  |  |  |  |  |  |  |  | 2087. |  |  |  |  |  |  |  |  |  | 2088. |  |  |  |  |  |  |  |  |  | 2089. |  |  |  |  |  |  |  |  |  | 2090. |  |  |  |  |  |  |  |  |  | 2091. |  |  |  |  |  |  |  |  |  | 2092. |  |  |  |  |  |  |  |  |  | 2093. |  |  |  |  |  |  |  |  |  | 2094. |  |  |  |  |  |  |  |  |  | 2095. |  |  |  |  |  |  |  |  |  | 2096. |  |  |  |  |  |  |  |  |  | 2097. |  |  |  |  |  |  |  |  |  | 2098. |  |  |  |  |  |  |  |  |  | 2099. |  |  |  |  |  |  |  |  |  | 2100. |  |  |  |  |  |  |  |  |  | 2101. |  |  |  |  |  |  |  |  |  | 2102. |  |  |  |  |  |  |  |  |  | 2103. |  |  |  |  |  |  |  |  |  | 2104. |  |  |  |  |  |  |  |  |  | 2105. |  |  |  |  |  |  |  |  |  | 2106. |  |  |  |  |  |  |  |  |  | 2107. |  |  |  |  |  |  |  |  |  | 2108. |  |  |  |  |  |  |  |  |  | 2109. |  |  |  |  |  |  |  |  |  | 2110. |  |  |  |  |  |  |  |  |  | 2111. |  |  |  |  |  |  |  |  |  | 2112. |  |  |  |  |  |  |  |  |  | 2113. |  |  |  |  |  |  |  |  |  | 2114. |  |  |  |  |  |  |  |  |  | 2115. |  |  |  |  |  |  |  |  |  | 2116. |  |  |  |  |  |  |  |  |  | 2117. |  |  |  |  |  |  |  |  |  | 2118. |  |  |  |  |  |  |  |  |  | 2119. |  |  |  |  |  |  |  |  |  | 2120. |  |  |  |  |  |  |  |  |  | 2121. |  |  |  |  |  |  |  |  |  | 2122. |  |  |  |  |  |  |  |  |  | 2123. |  |  |  |  |  |  |  |  |  | 2124. |  |  |  |  |  |  |  |  |  | 2125. |  |  |  |  |  |  |  |  |  | 2126. |  |  |  |  |  |  |  |  |  | 2127. |  |  |  |  |  |  |  |  |  | 2128. |  |  |  |  |  |  |  |  |  | 2129. |  |  |  |  |  |  |  |  |  | 2130. |  |  |  |  |  |  |  |  |  | 2131. |  |  |  |  |  |  |  |  |  | 2132. |  |  |  |  |  |  |  |  |  | 2133. |  |  |  |  |  |  |  |  |  | 2134. |  |  |  |  |  |  |  |  |  | 2135. |  |  |  |  |  |  |  |  |  | 2136. |  |  |  |  |  |  |  |  |  | 2137. |  |  |  |  |  |  |  |  |  | 2138. |  |  |  |  |  |  |  |  |  | 2139. |  |  |  |  |  |  |  |  |  | 2140. |  |  |  |  |  |  |  |  |  | 2141. |  |  |  |  |  |  |  |  |  | 2142. |  |  |  |  |  |  |  |  |  | 2143. |  |  |  |  |  |  |  |  |  | 2144. |  |  |  |  |  |  |  |  |  | 2145. |  |  |  |  |  |  |  |  |  | 2146. |  |  |  |  |  |  |  |  |  | 2147. |  |  |  |  |  |  |  |  |  | 2148. |  |  |  |  |  |  |  |  |  | 2149. |  |  |  |  |  |  |  |  |  | 2150. |  |  |  |  |  |  |  |  |  | 2151. |  |  |  |  |  |  |  |  |  | 2152. |  |  |  |  |  |  |  |  |  | 2153. |  |  |  |  |  |  |  |  |  | 2154. |  |  |  |  |  |  |  |  |  | 2155. |  |  |  |  |  |  |  |  |  | 2156. |  |  |  |  |  |  |  |  |  | 2157. |  |  |  |  |  |  |  |  |  | 2158. |  |  |  |  |  |  |  |  |  | 2159. |  |  |  |  |  |  |  |  |  | 2160. |  |  |  |  |  |  |  |  |  | 2161. |  |  |  |  |  |  |  |  |  | 2162. |  |  |  |  |  |  |  |  |  | 2163. |  |  |  |  |  |  |  |  |  | 2164. |  |  |  |  |  |  |  |  |  | 2165. |  |  |  |  |  |  |  |  |  | 2166. |  |  |  |  |  |  |  |  |  | 2167. |  |  |  |  |  |  |  |  |  | 2168. |  |  |  |  |  |  |  |  |  | 2169. |  |  |  |  |  |  |  |  |  | 2170. |  |  |  |  |  |  |  |  |  | 2171. |  |  |  |  |  |  |  |  |  | 2172. |  |  |  |  |  |  |  |  |  | 2173. |  |  |  |  |  |  |  |  |  | 2174. |  |  |  |  |  |  |  |  |  | 2175. |  |  |  |  |  |  |  |  |  | 2176. |  |  |  |  |  |  |  |  |  | 2177. |  |  |  |  |  |  |  |  |  | 2178. |  |  |  |  |  |  |  |  |  | 2179. |  |  |  |  |  |  |  |  |  | 2180. |  |  |  |  |  |  |  |  |  | 2181. |  |  |  |  |  |  |  |  |  | 2182. |  |  |  |  |  |  |  |  |  | 2183. |  |  |  |  |  |  |  |  |  | 2184. |  |  |  |  |  |  |  |  |  | 2185. |  |  |  |  |  |  |  |  |  | 2186. |  |  |  |  |  |  |  |  |  | 2187. |  |  |  |  |  |  |  |  |  | 2188. |  |  |  |  |  |  |  |  |  | 2189. |  |  |  |  |  |  |  |  |  | 2190. |  |  |  |  |  |  |  |  |  | 2191. |  |  |  |  |  |  |  |  |  | 2192. |  |  |  |  |  |  |  |  |  | 2193. |  |  |  |  |  |  |  |  |  | 2194. |  |  |  |  |  |  |  |  |  | 2195. |  |  |  |  |  |  |  |  |  | 2196. |  |  |  |  |  |  |  |  |  | 2197. |  |  |  |  |  |  |  |  |  | 2198. |  |  |  |  |  |  |  |  |  | 2199. |  |  |  |  |  |  |  |  |  | 2200. |  |  |  |  |  |  |  |  |  | 2201. |  |  |  |  |  |  |  |  |  | 2202. |  |  |  |  |  |  |  |  |  | 2203. |  |  |  |  |  |  |  |  |  | 2204. |  |  |  |  |  |  |  |  |  | 2205. |  |  |  |  |  |  |  |  |  | 2206. |  |  |  |  |  |  |  |  |  | 2207. |  |  |  |  |  |  |  |  |  | 2208. |  |  |  |  |  |  |  |  |  | 2209. |  |  |  |  |  |  |  |  |  | 2210. |  |  |  |  |  |  |  |  |  | 2211. |  |  |  |  |  |  |  |  |  | 2212. |  |  |  |  |  |  |  |  |  | 2213. |  |  |  |  |  |  |  |  |  | 2214. |  |  |  |  |  |  |  |  |  | 2215. |  |  |  |  |  |  |  |  |  | 2216. |  |  |  |  |  |  |  |  |  | 2217. |  |  |  |  |  |  |  |  |  | 2218. |  |  |  |  |  |  |  |  |  | 2219. |  |  |  |  |  |  |  |  |  | 2220. |  |  |  |  |  |  |  |  |  | 2221. |  |  |  |  |  |  |  |  |  | 2222. |  |  |  |  |  |  |  |  |  | 2223. |  |  |  |  |  |  |  |  |  | 2224. |  |  |  |  |  |  |  |  |  | 2225. |  |  |  |  |  |  |  |  |  | 2226. |  |  |  |  |  |  |  |  |  | 2227. |  |  |  |  |  |  |  |  |  | 2228. |  |  |  |  |  |  |  |  |  | 2229. |  |  |  |  |  |  |  |  |  | 2230. |  |  |  |  |  |  |  |  |  | 2231. |  |  |  |  |  |  |  |  |  | 2232. |  |  |  |  |  |  |  |  |  | 2233. |  |  |  |  |  |  |  |  |  | 2234. |  |  |  |  |  |  |  |  |  | 2235. |  |  |  |  |  |  |  |  |  | 2236. |  |  |  |  |  |  |  |  |  | 2237. |  |  |  |  |  |  |  |  |  | 2238. |  |  |  |  |  |  |  |  |  | 2239. |  |  |  |  |  |  |  |  |  | 2240. |  |  |  |  |  |  |  |  |  | 2241. |  |  |  |  |  |  |  |  |  | 2242. |  |  |  |  |  |  |  |  |  | 2243. |  |  |  |  |  |  |  |  |  | 2244. |  |  |  |  |  |  |  |  |  | 2245. |  |  |  |  |  |  |  |  |  | 2246. |  |  |  |  |  |  |  |  |  | 2247. |  |  |  |  |  |  |  |  |  | 2248. |  |  |  |  |  |  |  |  |  | 2249. |  |  |  |  |  |  |  |  |  | 2250. |  |  |  |  |  |  |  |  |  | 2251. |  |  |  |  |  |  |  |  |  | 2252. |  |  |  |  |  |  |  |  |  | 2253. |  |  |  |  |  |  |  |  |  | 2254. |  |  |  |  |  |  |  |  |  | 2255. |  |  |  |  |  |  |  |  |  | 2256. |  |  |  |  |  |  |  |  |  | 2257. |  |  |  |  |  |  |  |  |  | 2258. |  |  |  |  |  |  |  |  |  | 2259. |  |  |  |  |  |  |  |  |  | 2260. |  |  |  |  |  |  |  |  |  | 2261. |  |  |  |  |  |  |  |  |  | 2262. |  |  |  |  |  |  |  |  |  | 2263. |  |  |  |  |  |  |  |  |  | 2264. |  |  |  |  |  |  |  |  |  | 2265. |  |  |  |  |  |  |  |  |  | 2266. |  |  |  |  |  |  |  |  |  | 2267. |  |  |  |  |  |  |  |  |  | 2268. |  |  |  |  |  |  |  |  |  | 2269. |  |  |  |  |  |  |  |  |  | 2270. |  |  |  |  |  |  |  |  |  | 2271. |  |  |  |  |  |  |  |  |  | 2272. |  |  |  |  |  |  |  |  |  | 2273. |  |  |  |  |  |  |  |  |  | 2274. |  |  |  |  |  |  |  |  |  | 2275. |  |  |  |  |  |  |  |  |  | 2276. |  |  |  |  |  |  |  |  |  | 2277. |  |  |  |  |  |  |  |  |  | 2278. |  |  |  |  |  |  |  |  |  | 2279. |  |  |  |  |  |  |  |  |  | 2280. |  |  |  |  |  |  |  |  |  | 2281. |  |  |  |  |  |  |  |  |  | 2282. |  |  |  |  |  |  |  |  |  | 2283. |  |  |  |  |  |  |  |  |  | 2284. |  |  |  |  |  |  |  |  |  | 2285. |  |  |  |  |  |  |  |  |  | 2286. |  |  |  |  |  |  |  |  |  | 2287. |  |  |  |  |  |  |  |  |  | 2288. |  |  |  |  |  |  |  |  |  | 2289. |  |  |  |  |  |  |  |  |  | 2290. |  |  |  |  |  |  |  |  |  | 2291. |  |  |  |  |  |  |  |  |  | 2292. |  |  |  |  |  |  |  |  |  | 2293. |  |  |  |  |  |  |  |  |  | 2294. |  |  |  |  |  |  |  |  |  | 2295. |  |  |  |  |  |  |  |  |  | 2296. |  |  |  |  |  |  |  |  |  | 2297. |  |  |  |  |  |  |  |  |  | 2298. |  |  |  |  |  |  |  |  |  | 2299. |  |  |  |  |  |  |  |  |  | 2300. |  |  |  |  |  |  |  |  |  | 2301. |  |  |  |  |  |  |  |  |  | 2302. |  |  |  |  |  |  |  |  |  | 2303. |  |  |  |  |  |  |  |  |  | 2304. |  |  |  |  |  |  |  |  |  | 2305. |  |  |  |  |  |  |  |  |  | 2306. |  |  |  |  |  |  |  |  |  | 2307. |  |  |  |  |  |  |  |  |  | 2308. |  |  |  |  |  |  |  |  |  | 2309. |  |  |  |  |  |  |  |  |  | 2310. |  |  |  |  |  |  |  |  |  | 2311. |  |  |  |  |  |  |  |  |  | 2312. |  |  |  |  |  |  |  |  |  | 2313. |  |  |  |  |  |  |  |  |  | 2314. |  |  |  |  |  |  |  |  |  | 2315. |  |  |  |  |  |  |  |  |  | 2316. |  |  |  |  |  |  |  |  |  | 2317. |  |  |  |  |  |  |  |  |  | 2318. |  |  |  |  |  |  |  |  |  | 2319. |  |  |  |  |  |  |  |  |  | 2320. |  |  |  |  |  |  |  |  |  | 2321. |  |  |  |  |  |  |  |  |  | 2322. |  |  |  |  |  |  |  |  |  | 2323. |  |  |  |  |  |  |  |  |  | 2324. |  |  |  |  |  |  |  |  |  | 2325. |  |  |  |  |  |  |  |  |  | 2326. |  |  |  |  |  |  |  |  |  | 2327. |  |  |  |  |  |  |  |  |  | 2328. |  |  |  |  |  |  |  |  |  | 2329. |  |  |  |  |  |  |  |  |  | 2330. |  |  |  |  |  |  |  |  |  | 2331. |  |  |  |  |  |  |  |  |  | 2332. |  |  |  |  |  |  |  |  |  | 2333. |  |  |  |  |  |  |  |  |  | 2334. |  |  |  |  |  |  |  |  |  | 2335. |  |  |  |  |  |  |  |  |  | 2336. |  |  |  |  |  |  |  |  |  | 2337. |  |  |  |  |  |  |  |  |  | 2338. |  |  |  |  |  |  |  |  |  | 2339. |  |  |  |  |  |  |  |  |  | 2340. |  |  |  |  |  |  |  |  |  | 2341. |  |  |  |  |  |  |  |  |  | 2342. |  |  |  |  |  |  |  |  |  | 2343. |  |  |  |  |  |  |  |  |  | 2344. |  |  |  |  |  |  |  |  |  | 2345. |  |  |  |  |  |  |  |  |  | 2346. |  |  |  |  |  |  |  |  |  | 2347. |  |  |  |  |  |  |  |  |  | 2348. |  |  |  |  |  |  |  |  |  | 2349. |  |  |  |  |  |  |  |  |  | 2350. |  |  |  |  |  |  |  |  |  | 2351. |  |  |  |  |  |  |  |  |  | 2352. |  |  |  |  |  |  |  |  |  | 2353. |  |  |  |  |  |  |  |  |  | 2354. |  |  |  |  |  |  |  |  |  | 2355. |  |  |  |  |  |  |  |  |  | 2356. |  |  |  |  |  |  |  |  |  | 2357. |  |  |  |  |  |  |  |  |  | 2358. |  |  |  |  |  |  |  |  |  | 2359. |  |  |  |  |  |  |  |  |  | 2360. |  |  |  |  |  |  |  |  |  | 2361. |  |  |  |  |  |  |  |  |  | 2362. |  |  |  |  |  |  |  |  |  | 2363. |  |  |  |  |  |  |  |  |  | 2364. |  |  |  |  |  |  |  |  |  | 2365. |  |  |  |  |  |  |  |  |  | 2366. |  |  |  |  |  |  |  |  |  | 2367. |  |  |  |  |  |  |  |  |  | 2368. |  |  |  |  |  |  |  |  |  | 2369. |  |  |  |  |  |  |  |  |  | 2370. |  |  |  |  |  |  |  |  |  | 2371. |  |  |  |  |  |  |  |  |  | 2372. |  |  |  |  |  |  |  |  |  | 2373. |  |  |  |  |  |  |  |  |  | 2374. |  |  |  |  |  |  |  |  |  | 2375. |  |  |  |  |  |  |  |  |  | 2376. |  |  |  |  |  |  |  |  |  | 2377. |  |  |  |  |  |  |  |  |  | 2378. |  |  |  |  |  |  |  |  |  | 2379. |  |  |  |  |  |  |  |  |  | 2380. |  |  |  |  |  |  |  |  |  | 2381. |  |  |  |  |  |  |  |  |  | 2382. |  |  |  |  |  |  |  |  |  | 2383. |  |  |  |  |  |  |  |  |  | 2384. |  |  |  |  |  |  |  |  |  | 2385. |  |  |  |  |  |  |  |  |  | 2386. |  |  |  |  |  |  |  |  |  | 2387. |  |  |  |  |  |  |  |  |  | 2388. |  |  |  |  |  |  |  |  |  | 2389. |  |  |  |  |  |  |  |  |  | 2390. |  |  |  |  |  |  |  |  |  | 2391. |  |  |  |  |  |  |  |  |  | 2392. |  |  |  |  |  |  |  |  |  | 2393. |  |  |  |  |  |  |  |  |  | 2394. |  |  |  |  |  |  |  |  |  | 2395. |  |  |  |  |  |  |  |  |  | 2396. |  |  |  |  |  |  |  |  |  | 2397. |  |  |  |  |  |  |  |  |  | 2398. |  |  |  |  |  |  |  |  |  | 2399. |  |  |  |  |  |  |  |  |  | 2400. |  |  |  |  |  |  |  |  |  | 2401. |  |  |  |  |  |  |  |  |  | 2402. |  |  |  |  |  |  |  |  |  | 2403. |  |  |  |  |  |  |  |  |  | 2404. |  |  |  |  |  |  |  |  |  | 2405. |  |  |  |  |  |  |  |  |  | 2406. |  |  |  |  |  |  |  |  |  | 2407. |  |  |  |  |  |  |  |  |  | 2408. |  |  |  |  |  |  |  |  |  | 2409. |  |  |  |  |  |  |  |  |  | 2410. |  |  |  |  |  |  |  |  |  | 2411. |  |  |  |  |  |  |  |  |  | 2412. |  |  |  |  |  |  |  |  |  | 2413. |  |  |  |  |  |  |  |  |  | 2414. |  |  |  |  |  |  |  |  |  | 2415. |  |  |  |  |  |  |  |  |  | 2416. |  |  |  |  |  |  |  |  |  | 2417. |  |  |  |  |  |  |  |  |  | 2418. |  |  |  |  |  |  |  |  |  | 2419. |  |  |  |  |  |  |  |  |  | 2420. |  |  |  |  |  |  |  |  |  | 2421. |  |  |  |  |  |  |  |  |  | 2422. |  |  |  |  |  |  |  |  |  | 2423. |  |  |  |  |  |  |  |  |  | 2424. |  |  |  |  |  |  |  |  |  | 2425. |  |  |  |  |  |  |  |  |  | 2426. |  |  |  |  |  |  |  |  |  | 2427. |  |  |  |  |  |  |  |  |  | 2428. |  |  |  |  |  |  |  |  |  | 2429. |  |  |  |  |  |  |  |  |  | 2430. |  |  |  |  |  |  |  |  |  | 2431. |  |  |  |  |  |  |  |  |  | 2432. |  |  |  |  |  |  |  |  |  | 2433. |  |  |  |  |  |  |  |  |  | 2434. |  |  |  |  |  |  |  |  |  | 2435. |  |  |  |  |  |  |  |  |  | 2436. |  |  |  |  |  |  |  |  |  | 2437. |  |  |  |  |  |  |  |  |  | 2438. |  |  |  |  |  |  |  |  |  | 2439. |  |  |  |  |  |  |  |  |  | 2440. |  |  |  |  |  |  |  |  |  | 2441. |  |  |  |  |  |  |  |  |  | 2442. |  |  |  |  |  |  |  |  |  | 2443. |  |  |  |  |  |  |  |  |  | 2444. |  |  |  |  |  |  |  |  |  | 2445. |  |  |  |  |  |  |  |  |  | 2446. |  |  |  |  |  |  |  |  |  | 2447. |  |  |  |  |  |  |  |  |  | 2448. |  |  |  |  |  |  |  |  |  | 2449. |  |  |  |  |  |  |  |  |  | 2450. |  |  |  |  |  |  |  |  |  | 2451. |  |  |  |  |  |  |  |  |  | 2452. |  |  |  |  |  |  |  |  |  | 2453. |  |  |  |  |  |  |  |  |  | 2454. |  |  |  |  |  |  |  |  |  | 2455. |  |  |  |  |  |  |  |  |  | 2456. |  |  |  |  |  |  |  |  |  | 2457. |  |  |  |  |  |  |  |  |  | 2458. |  |  |  |  |  |  |  |  |  | 2459. |  |  |  |  |  |  |  |  |  | 2460. |  |  |  |  |  |  |  |  |  | 2461. |  |  |  |  |  |  |  |  |  | 2462. |  |  |  |  |  |  |  |  |  | 2463. |  |  |  |  |  |  |  |  |  | 2464. |  |  |  |  |  |  |  |  |  | 2465. |  |  |  |  |  |  |  |  |  | 2466. |  |  |  |  |  |  |  |  |  | 2467. |  |  |  |  |  |  |  |  |  | 2468. |  |  |  |  |  |  |  |  |  | 2469. |  |  |  |  |  |  |  |  |  | 2470. |  |  |  |  |  |  |  |  |  | 2471. |  |  |  |  |  |  |  |  |  | 2472. |  |  |  |  |  |  |  |  |  | 2473. |  |  |  |  |  |  |  |  |  | 2474. |  |  |  |  |  |  |  |  |  | 2475. |  |  |  |  |  |  |  |  |  | 2476. |  |  |  |  |  |  |  |  |  | 2477. |  |  |  |  |  |  |  |  |  | 2478. |  |  |  |  |  |  |  |  |  | 2479. |  |  |  |  |  |  |  |  |  | 2480. |  |  |  |  |  |  |  |  |  | 2481. |  |  |  |  |  |  |  |  |  | 2482. |  |  |  |  |  |  |  |  |  | 2483. |  |  |  |  |  |  |  |  |  | 2484. |  |  |  |  |  |  |  |  |  | 2485. |  |  |  |  |  |  |  |  |  | 2486. |  |  |  |  |  |  |  |  |  | 2487. |  |  |  |  |  |  |  |  |  | 2488. |  |  |  |  |  |  |  |  |  | 2489. |  |  |  |  |  |  |  |  |  | 2490. |  |  |  |  |  |  |  |  |  | 2491. |  |  |  |  |  |  |  |  |  | 2492. |  |  |  |  |  |  |  |  |  | 2493. |  |  |  |  |  |  |  |  |  | 2494. |  |  |  |  |  |  |  |  |  | 2495. |  |  |  |  |  |  |  |  |  | 2496. |  |  |  |  |  |  |  |  |  | 2497. |  |  |  |  |  |  |  |  |  | 2498. |  |  |  |  |  |  |  |  |  | 2499. |  |  |  |  |  |  |  |  |  | 2500. |  |  |  |  |  |  |  |  |  | 2501. |  |  |  |  |  |  |  |  |  | 2502. |  |  |  |  |  |  |  |  |  | 2503. |  |  |  |  |  |  |  |  |  | 2504. |  |  |  |  |  |  |  |  |  | 2505. |  |  |  |  |  |  |  |  |  | 2506. |  |  |  |  |  |  |  |  |  | 2507. |  |  |  |  |  |  |  |  |  | 2508. |  |  |  |  |  |  |  |  |  | 2509. |  |  |  |  |  |  |  |  |  | 2510. |  |  |  |  |  |  |  |  |  | 2511. |  |  |  |  |  |  |  |  |  | 2512. |  |  |  |  |  |  |  |  |  | 2513. |  |  |  |  |  |  |  |  |  | 2514. |  |  |  |  |  |  |  |  |  | 2515. |  |  |  |  |  |  |  |  |  | 2516. |  |  |  |  |  |  |  |  |  | 2517. |  |  |  |  |  |  |  |  |  | 2518. |  |  |  |  |  |  |  |  |  | 2519. |  |  |  |  |  |  |  |  |  | 2520. |  |  |  |  |  |  |  |  |  | 2521. |  |  |  |  |  |  |  |  |  | 2522. |  |  |  |  |  |  |  |  |  | 2523. |  |  |  |  |  |  |  |  |  | 2524. |  |  |  |  |  |  |  |  |  | 2525. |  |  |  |  |  |  |  |  |  | 2526. |  |  |  |  |  |  |  |  |  | 2527. |  |  |  |  |  |  |  |  |  | 2528. |  |  |  |  |  |  |  |  |  | 2529. |  |  |  |  |  |  |  |  |  | 2530. |  |  |  |  |  |  |  |  |  | 2531. |  |  |  |  |  |  |  |  |  | 2532. |  |  |  |  |  |  |  |  |  | 2533. |  |  |  |  |  |  |  |  |  | 2534. |  |  |  |  |  |  |  |  |  | 2535. |  |  |  |  |  |  |  |  |  | 2536. |  |  |  |  |  |  |  |  |  | 2537. |  |  |  |  |  |  |  |  |  | 2538. |  |  |  |  |  |  |  |  |  | 2539. |  |  |  |  |  |  |  |  |  | 2540. |  |  |  |  |  |  |  |  |  | 2541. |  |  |  |  |  |  |  |  |  | 2542. |  |  |  |  |  |  |  |  |  | 2543. |  |  |  |  |  |  |  |  |  | 2544. |  |  |  |  |  |  |  |  |  | 2545. |  |  |  |  |  |  |  |  |  | 2546. |  |  |  |  |  |  |  |  |  | 2547. |  |  |  |  |  |  |  |  |  | 2548. |  |  |  |  |  |  |  |  |  | 2549. |  |  |  |  |  |  |  |  |  | 2550. |  |  |  |  |  |  |  |  |  | 2551. |  |  |  |  |  |  |  |  |  | 2552. |  |  |  |  |  |  |  |  |  | 2553. |  |  |  |  |  |  |  |  |  | 2554. |  |  |  |  |  |  |  |  |  | 2555. |  |  |  |  |  |  |  |  |  | 2556. |  |  |  |  |  |  |  |  |  | 2557. |  |  |  |  |  |  |  |  |  | 2558. |  |  |  |  |  |  |  |  |  | 2559. |  |  |  |  |  |  |  |  |  | 2560. |  |  |  |  |  |  |  |  |  | 2561. |  |  |  |  |  |  |  |  |  | 2562. |  |  |  |  |  |  |  |  |  | 2563. |  |  |  |  |  |  |  |  |  | 2564. |  |  |  |  |  |  |  |  |  | 2565. |  |  |  |  |  |  |  |  |  | 2566. |  |  |  |  |  |  |  |  |  | 2567. |  |  |  |  |  |  |  |  |  | 2568. |  |  |  |  |  |  |  |  |  | 2569. |  |  |  |  |  |  |  |  |  | 2570. |  |  |  |  |  |  |  |  |  | 2571. |  |  |  |  |  |  |  |  |  | 2572. |  |  |  |  |  |  |  |  |  | 2573. |  |  |  |  |  |  |  |  |  | 2574. |  |  |  |  |  |  |  |  |  | 2575. |  |  |  |  |  |  |  |  |  | 2576. |  |  |  |  |  |  |  |  |  | 2577. |  |  |  |  |  |  |  |  |  | 2578. |  |  |  |  |  |  |  |  |  | 2579. |  |  |  |  |  |  |  |  |  | 2580. |  |  |  |  |  |  |  |  |  | 2581. |  |  |  |  |  |  |  |  |  | 2582. |  |  |  |  |  |  |  |  |  | 2583. |  |  |  |  |  |  |  |  |  | 2584. |  |  |  |  |  |  |  |  |  | 2585. |  |  |  |  |  |  |  |  |  | 2586. |  |  |  |  |  |  |  |  |  | 2587. |  |  |  |  |  |  |  |  |  | 2588. |  |  |  |  |  |  |  |  |  | 2589. |  |  |  |  |  |  |  |  |  | 2590. |  |  |  |  |  |  |  |  |  | 2591. |  |  |  |  |  |  |  |  |  | 2592. |  |  |  |  |  |  |  |  |  | 2593. |  |  |  |  |  |  |  |  |  | 2594. |  |  |  |  |  |  |  |  |  | 2595. |  |  |  |  |  |  |  |  |  | 2596. |  |  |  |  |  |  |  |  |  | 2597. |  |  |  |  |  |  |  |  |  | 2598. |  |  |  |  |  |  |  |  |  | 2599. |  |  |  |  |  |  |  |  |  | 2600. |  |  |  |  |  |  |  |  |  | 2601. |  |  |  |  |  |  |  |  |  | 2602. |  |  |  |  |  |  |  |  |  | 2603. |  |  |  |  |  |  |  |  |  | 2604. |  |  |  |  |  |  |  |  |  | 2605. |  |  |  |  |  |  |  |  |  | 2606. |  |  |  |  |  |  |  |  |  | 2607. |  |  |  |  |  |  |  |  |  | 2608. |  |  |  |  |  |  |  |  |  | 2609. |  |  |  |  |  |  |  |  |  | 2610. |  |  |  |  |  |  |  |  |  | 2611. |  |  |  |  |  |  |  |  |  | 2612. |  |  |  |  |  |  |  |  |  | 2613. |  |  |  |  |  |  |  |  |  | 2614. |  |  |  |  |  |  |  |  |  | 2615. |  |  |  |  |  |  |  |  |  | 2616. |  |  |  |  |  |  |  |  |  | 2617. |  |  |  |  |  |  |  |  |  | 2618. |  |  |  |  |  |  |  |  |  | 2619. |  |  |  |  |  |  |  |  |  | 2620. |  |  |  |  |  |  |  |  |  | 2621. |  |  |  |  |  |  |  |  |  | 2622. |  |  |  |  |  |  |  |  |  | 2623. |  |  |  |  |  |  |  |  |  | 2624. |  |  |  |  |  |  |  |  |  | 2625. |  |  |  |  |  |  |  |  |  | 2626. |  |  |  |  |  |  |  |  |  | 2627. |  |  |  |  |  |  |  |  |  | 2628. |  |  |  |  |  |  |  |  |  | 2629. |  |  |  |  |  |  |  |  |  | 2630. |  |  |  |  |  |  |  |  |  | 2631. |  |  |  |  |  |  |  |  |  | 2632. |  |  |  |  |  |  |  |  |  | 2633. |  |  |  |  |  |  |  |  |  | 2634. |  |  |  |  |  |  |  |  |  | 2635. |  |  |  |  |  |  |  |  |  | 2636. |  |  |  |  |  |  |  |  |  | 2637. |  |  |  |  |  |  |  |  |  | 2638. |  |  |  |  |  |  |  |  |  | 2639. |  |  |  |  |  |  |  |  |  | 2640. |  |  |  |  |  |  |  |  |  | 2641. |  |  |  |  |  |  |  |  |  | 2642. |  |  |  |  |  |  |  |  |  | 2643. |  |  |  |  |  |  |  |  |  | 2644. |  |  |  |  |  |  |  |  |  | 2645. |  |  |  |  |  |  |  |  |  | 2646. |  |  |  |  |  |  |  |  |  | 2647. |  |  |  |  |  |  |  |  |  | 2648. |  |  |  |  |  |  |  |  |  | 2649. |  |  |  |  |  |  |  |  |  | 2650. |  |  |  |  |  |  |  |  |  | 2651. |  |  |  |  |  |  |  |  |  | 2652. |  |  |  |  |  |  |  |  |  | 2653. |  |  |  |  |  |  |  |  |  | 2654. |  |  |  |  |  |  |  |  |  | 2655. |  |  |  |  |  |  |  |  |  | 2656. |  |  |  |  |  |  |  |  |  | 2657. |  |  |  |  |  |  |  |  |  | 2658. |  |  |  |  |  |  |  |  |  | 2659. |  |  |  |  |  |  |  |  |  | 2660. |  |  |  |  |  |  |  |  |  | 2661. |  |  |  |  |  |  |  |  |  | 2662. |  |  |  |  |  |  |  |  |  | 2663. |  |  |  |  |  |  |  |  |  | 2664. |  |  |  |  |  |  |  |  |  | 2665. |  |  |  |  |  |  |  |  |  | 2666. |  |  |  |  |  |  |  |  |  | 2667. |  |  |  |  |  |  |  |  |  | 2668. |  |  |  |  |  |  |  |  |  | 2669. |  |  |  |  |  |  |  |  |  | 2670. |  |  |  |  |  |  |  |  |  | 2671. |  |  |  |  |  |  |  |  |  | 2672. |  |  |  |  |  |  |  |  |  | 2673. |  |  |  |  |  |  |  |  |  | 2674. |  |  |  |  |  |  |  |  |  | 2675. |  |  |  |  |  |  |  |  |  | 2676. |  |  |  |  |  |  |  |  |  | 2677. |  |  |  |  |  |  |  |  |  | 2678. |  |  |  |  |  |  |  |  |  | 2679. |  |  |  |  |  |  |  |  |  | 2680. |  |  |  |  |  |  |  |  |  | 2681. |  |  |  |  |  |  |  |  |  | 2682. |  |  |  |  |  |  |  |  |  | 2683. |  |  |  |  |  |  |  |  |  | 2684. |  |  |  |  |  |  |  |  |  | 2685. |  |  |  |  |  |  |  |  |  | 2686. |  |  |  |  |  |  |  |  |  | 2687. |  |  |  |  |  |  |  |  |  | 2688. |  |  |  |  |  |  |  |  |  | 2689. |  |  |  |  |  |  |  |  |  | 2690. |  |  |  |  |  |  |  |  |  | 2691. |  |  |  |  |  |  |  |  |  | 2692. |  |  |  |  |  |  |  |  |  | 2693. |  |  |  |  |  |  |  |  |  | 2694. |  |  |  |  |  |  |  |  |  | 2695. |  |  |  |  |  |  |  |  |  | 2696. |  |  |  |  |  |  |  |  |  | 2697. |  |  |  |  |  |  |  |  |  | 2698. |  |  |  |  |  |  |  |  |  | 2699. |  |  |  |  |  |  |  |  |  | 2700. |  |  |  |  |  |  |  |  |  | 2701. |  |  |  |  |  |  |  |  |  | 2702. |  |  |  |  |  |  |  |  |  | 2703. |  |  |  |  |  |  |  |  |  | 2704. |  |  |  |  |  |  |  |  |  | 2705. |  |  |  |  |  |  |  |  |  | 2706. |  |  |  |  |  |  |  |  |  | 2707. |  |  |  |  |  |  |  |  |  | 2708. |  |  |  |  |  |  |  |  |  | 2709. |  |  |  |  |  |  |  |  |  | 2710. |  |  |  |  |  |  |  |  |  | 2711. |  |  |  |  |  |  |  |  |  | 2712. |  |  |  |  |  |  |  |  |  | 2713. |  |  |  |  |  |  |  |  |  | 2714. |  |  |  |  |  |  |  |  |  | 2715. |  |  |  |  |  |  |  |  |  | 2716. |  |  |  |  |  |  |  |  |  | 2717. |  |  |  |  |  |  |  |  |  | 2718. |  |  |  |  |  |  |  |  |  | 2719. |  |  |  |  |  |  |  |  |  | 2720. |  |  |  |  |  |  |  |  |  | 2721. |  |  |  |  |  |  |  |  |  | 2722. |  |  |  |  |  |  |  |  |  | 2723. |  |  |  |  |  |  |  |  |  | 2724. |  |  |  |  |  |  |  |  |  | 2725. |  |  |  |  |  |  |  |  |  | 2726. |  |  |  |  |  |  |  |  |  | 2727. |  |  |  |  |  |  |  |  |  | 2728. |  |  |  |  |  |  |  |  |  | 2729. |  |  |  |  |  |  |  |  |  | 2730. |  |  |  |  |  |  |  |  |  | 2731. |  |  |  |  |  |  |  |  |  | 2732. |  |  |  |  |  |  |  |  |  | 2733. |  |  |  |  |  |  |  |  |  | 2734. |  |  |  |  |  |  |  |  |  | 2735. |  |  |  |  |  |  |  |  |  | 2736. |  |  |  |  |  |  |  |  |  | 2737. |  |  |  |  |  |  |  |  |  | 2738. |  |  |  |  |  |  |  |  |  | 2739. |  |  |  |  |  |  |  |  |  | 2740. |  |  |  |  |  |  |  |  |  | 2741. |  |  |  |  |  |  |  |  |  | 2742. |  |  |  |  |  |  |  |  |  | 2743. |  |  |  |  |  |  |  |  |  | 2744. |  |  |  |  |  |  |  |  |  | 2745. |  |  |  |  |  |  |  |  |  | 2746. |  |  |  |  |  |  |  |  |  | 2747. |  |  |  |  |  |  |  |  |  | 2748. |  |  |  |  |  |  |  |  |  | 2749. |  |  |  |  |  |  |  |  |  | 2750. |  |  |  |  |  |  |  |  |  | 2751. |  |  |  |  |  |  |  |  |  | 2752. |  |  |  |  |  |  |  |  |  | 2753. |  |  |  |  |  |  |  |  |  | 2754. |  |  |  |  |  |  |  |  |  | 2755. |  |  |  |  |  |  |  |  |  | 2756. |  |  |  |  |  |  |  |  |  | 2757. |  |  |  |  |  |  |  |  |  | 2758. |  |  |  |  |  |  |  |  |  | 2759. |  |  |  |  |  |  |  |  |  | 2760. |  |  |  |  |  |  |  |  |  | 2761. |  |  |  |  |  |  |  |  |  | 2762. |  |  |  |  |  |  |  |  |  | 2763. |  |  |  |  |  |  |  |  |  | 2764. |  |  |  |  |  |  |  |  |  | 2765. |  |  |  |  |  |  |  |  |  | 2766. |  |  |  |  |  |  |  |  |  | 2767. |  |  |  |  |  |  |  |  |  | 2768. |  |  |  |  |  |  |  |  |  | 2769. |  |  |  |  |  |  |  |  |  | 2770. |  |  |  |  |  |  |  |  |  | 2771. |  |  |  |  |  |  |  |  |  | 2772. |  |  |  |  |  |  |  |  |  | 2773. |  |  |  |  |  |  |  |  |  | 2774. |  |  |  |  |  |  |  |  |  | 2775. |  |  |  |  |  |  |  |  |  | 2776. |  |  |  |  |  |  |  |  |  | 2777. |  |  |  |  |  |  |  |  |  | 2778. |  |  |  |  |  |  |  |  |  | 2779. |  |  |  |  |  |  |  |  |  | 2780. |  |  |  |  |  |  |  |  |  | 2781. |  |  |  |  |  |  |  |  |  | 2782. |  |  |  |  |  |  |  |  |  | 2783. |  |  |  |  |  |  |  |  |  | 2784. |  |  |  |  |  |  |  |  |  | 2785. |  |  |  |  |  |  |  |  |  | 2786. |  |  |  |  |  |  |  |  |  | 2787. |  |  |  |  |  |  |  |  |  | 2788. |  |  |  |  |  |  |  |  |  | 2789. |  |  |  |  |  |  |  |  |  | 2790. |  |  |  |  |  |  |  |  |  | 2791. |  |  |  |  |  |  |  |  |  | 2792. |  |  |  |  |  |  |  |  |  | 2793. |  |  |  |  |  |  |  |  |  | 2794. |  |  |  |  |  |  |  |  |  | 2795. |  |  |  |  |  |  |  |  |  | 2796. |  |  |  |  |  |  |  |  |  | 2797. |  |  |  |  |  |  |  |  |  | 2798. |  |  |  |  |  |  |  |  |  | 2799. |  |  |  |  |  |  |  |  |  | 2800. |  |  |  |  |  |  |  |  |  | 2801. |  |  |  |  |  |  |  |  |  | 2802. |  |  |  |  |  |  |  |  |  | 2803. |  |  |  |  |  |  |  |  |  | 2804. |  |  |  |  |  |  |  |  |  | 2805. |  |  |  |  |  |  |  |  |  | 2806. |  |  |  |  |  |  |  |  |  | 2807. |  |  |  |  |  |  |  |  |  | 2808. |  |  |  |  |  |  |  |  |  | 2809. |  |  |  |  |  |  |  |  |  | 2810. |  |  |  |  |  |  |  |  |  | 2811. |  |  |  |  |  |  |  |  |  | 2812. |  |  |  |  |  |  |  |  |  | 2813. |  |  |  |  |  |  |  |  |  | 2814. |  |  |  |  |  |  |  |  |  | 2815. |  |  |  |  |  |  |  |  |  | 2816. |  |  |  |  |  |  |  |  |  | 2817. |  |  |  |  |  |  |  |  |  | 2818. |  |  |  |  |  |  |  |  |  | 2819. |  |  |  |  |  |  |  |  |  | 2820. |  |  |  |  |  |  |  |  |  | 2821. |  |  |  |  |  |  |  |  |  | 2822. |  |  |  |  |  |  |  |  |  | 2823. |  |  |  |  |  |  |  |  |  | 2824. |  |  |  |  |  |  |  |  |  | 2825. |  |  |  |  |  |  |  |  |  | 2826. |  |  |  |  |  |  |  |  |  | 2827. |  |  |  |  |  |  |  |  |  | 2828. |  |  |  |  |  |  |  |  |  | 2829. |  |  |  |  |  |  |  |  |  | 2830. |  |  |  |  |  |  |  |  |  | 2831. |  |  |  |  |  |  |  |  |  | 2832. |  |  |  |  |  |  |  |  |  | 2833. |  |  |  |  |  |  |  |  |  | 2834. |  |  |  |  |  |  |  |  |  | 2835. |  |  |  |  |  |  |  |  |  | 2836. |  |  |  |  |  |  |  |  |  | 2837. |  |  |  |  |  |  |  |  |  | 2838. |  |  |  |  |  |  |  |  |  | 2839. |  |  |  |  |  |  |  |  |  | 2840. |  |  |  |  |  |  |  |  |  |
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**JOURNAL**  
OF  
**THE FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**

OCTOBER, 1841.

**Civil Engineering.**

*Extracts from the Treatise on Geodesy, by L. B. FRANCEUR. Translated by W. H. EMORY, Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 154.]

*Terrestrial Geomorphology.—General Principles, Stations and Signals.*

109. To determine the relative position of the most prominent points of an extensive district of country, such as a province or kingdom, the most elevated points are selected commanding an extensive view of the surrounding country. From these places, called *stations*, the observations are made. When necessary, sheds are constructed at them, and *signals* which can be seen from the neighboring stations. To economize time, trouble and expense, and to attain greater precision, the stations should be as far apart as possible (usually 8 or 10 thousand metres, or 5 or 6 miles.) The stations joined by imaginary lines constitute a plexus formed of a series of large triangles, covering the entire country to be surveyed. All the elements of these triangles are either measured or calculated.

The engineer measures with extreme care all the angles of these triangles, and a distance called the *base*. This base is one of the sides of some one of the series of triangles. The lengths of all the other sides are found by calculation. This plexus is called a *canevas trigonometrique*.

These various triangles are, it is true, situated in space, and form a polyhedron with triangular faces enveloping the ground. But, if a perpendicular line is let fall from each summit, it meets a point under ground on the level of the surface of the sea. This surface is considered in geodesy that of the terrestrial spheroid, because the inequalities

of the mountains compared with the immense magnitude of the globe become insignificant and may be neglected. Thus we substitute for right lined triangles determined by observation, curvelinear triangles obtained by calculation. The projection of the observed triangles on the terrestrial spheroid is called *reducing them to the horizon*. As the figure of the spheroid differs very little from that of a sphere, each of these projections is assumed to be made on a sphere of a certain radius, regard being had to the smallness of each triangle. This radius varies with the place.

The largest triangles in the plexus are called *triangles of the first order*. When they are established, other stations within them are selected, and connected with them by observations made with great care, though not with as much as the observations made for the primitive triangles. The triangles of the second order, smaller than those of the first, are thus established.

These in their turn are made use of to form the *triangles of the third order*. When their sides do not exceed six hundred or a thousand metres (656 or 1095 yards) in length, the curvature is so little appreciable that they may be regarded as right lines. These lengths serve to determine positions in detail, and complete the topography. Thus geomorphy embraces the exact determination of the triangles of the first, second and third orders, and their projection upon the terrestrial spheroid.

110. It is also proposed to show under this head the manner of finding the length of an arc of the meridian traversing a plexus. It is evident that this length cannot be measured satisfactorily. The operation of measuring a base of 6 or 7 miles, on even ground is extremely difficult, how much more so then would it become to measure a large terrestrial arc traversing hills, mountains, and other obstacles. It can only be attained by calculating the arc in parts as will be explained.

The terrestrial meridian which traverses France, from Dunkirk to Barcelona was obtained in this manner; the arc has since been produced beyond these limits. Arcs perpendicular to this meridian have also been determined. By these operations, the figure and dimensions of the terrestrial spheroid, the length of the metre, &c., have been ascertained.

The *longitude* and *latitude* of each station, and the *azimuth* of each side of the triangle is also necessary to be known. Astronomical observations furnish these elements for some of these stations, and calculation gives them for others.

The elevation of each station above the surrounding ground, and

above the terrestrial spheroid is called the *altitude*, and is ascertained by leveling.

These are the subjects it is proposed to treat in geomorphy.

111. We will now examine the best manner of placing the stations with regard to each other to insure correct results.

Let  $a b c$  (fig. 32 see plate II., vol. 1,) be the sides of any triangle, and  $A B C$  the angles respectively opposite to them,

$$\text{we have } a \sin. B = b \sin. A. \quad (1)$$

This equation gives the side  $a$  when we know  $A, B$ , and  $b$ . Now if any little error has been committed in the measurement of these angles, for example an error at  $A$  equal to  $y$ , and one at  $B$  equal to  $y'$ ,  $b$  being supposed correct, instead of using the values  $A$  and  $B$ , we use the erroneous ones  $A + y$  and  $B + y'$ . This will make an error in the value of  $x$  expressed by  $b$ ; and equat. (1) becomes

$$(a + x) \sin. (B + y') = b \sin. (A + y).$$

Develope these sines, and as  $y$  and  $y'$  are always very small, substitute their arcs for their sines, and 1 for their cosines; it will then become

$$(a + x) (\sin. B + y \cos. B) = b (\sin. A + y \cos. A).$$

Reduce this by the aid of equation (1) and suppress the product  $x y' \cos. B$ , and we have

$$x \sin. B + a y' \cos. B = b y \cos. A,$$

and by placing  $\frac{a \sin. B}{\sin. A}$  for  $b$ , we have

$$x = a (y \cos. A - y' \cos. B).$$

This then is the error in the sine  $a$  produced by the errors of observation  $y$  and  $y'$  at the angles  $A$  and  $B$ .

It is evident that  $x$  is small in proportion as  $A$  and  $B$  approach equality, supposing  $y$  and  $y'$  equal; and the error is nothing when  $y$  and  $y'$  are equal and of the same algebraic sign and  $A = B$ . In this case the side  $a$  is given correctly by calculation, although erroneous observations have been used. If the errors  $y$  and  $y'$  are equal and of contrary signs, the equation becomes  $x = a y (\cos. A + \cos. B)$ , which the condition  $A = B$  makes a *minimum*.

$$\text{We have } x = a y \left( \frac{\cos. A}{\sin. A} + \frac{\cos. B}{\sin. B} \right) = a y \frac{\sin. (A + B)}{\sin. A \sin. B}$$

and by substituting  $\frac{\cos. (A-B) + \cos. C}{2}$  for  $\sin. A \sin. B$ . (See trigonometry.)

we have  $x = a y \frac{2 \sin. C}{\cos. (A-B) + \cos. C}$ , an expression which has evidently the smallest possible value when  $A = B$ .



We see then, that for the purpose of reducing the error, it is most favourable under any circumstances that the triangle should be *equilateral*. When the sides sought are each equal to the measured side, it may be regarded as certain, that the error of the angles is insensible. But, as it is frequently impossible to have the triangle equilateral, we are satisfied with approaching this condition by never admitting an angle of a triangle less than  $30^\circ$ . We say then that *the triangle is well adapted*. The stations should be chosen to conform to this principle as nearly as possible.

112. Suppose now that the side  $b$  is not of the proper length, but that the angles  $A$  and  $B$  are correct. The true value of  $b$  will be replaced by  $b + z$ , and  $a$  by  $a + x$ ;  $z$  and  $x$  being the errors;

$$\text{then } (a + x) \sin. B = (b + z) \sin. A,$$

$$\text{and } x \sin. B = z \sin. A; \quad x = z \frac{\sin. A}{\sin. B}$$

Thus the smaller the angle  $B$  is, the greater will be the effect of the error  $z$  on the opposite side  $a$ . When  $B = 30^\circ$ , the smallest limit allowed, we have  $\sin. B = \frac{1}{2}$ ,  $x = 2z \sin. A$ . But then  $A + C = 150^\circ$ , and each of the angles  $A$  and  $B$  should be nearly  $75^\circ$ ; the  $\sin. A$  then differs little from 1, and  $x$  from  $2z$ . Thus the error  $z$  committed on the side  $b$  is carried to the side  $a$  and doubled. In this manner the error increases from one triangle to another until in the end it is very great.

We conclude therefore that in a triangle well adapted, a small error committed in measuring the length of one of the sides, is much more mischievous than an error made in the measurement of the angles, because in the first, under favourable circumstances, it increases, and may even become doubled in calculating the other sides, while errors from the angles do not necessarily alter the value of the sides deduced from them. It is evident then that the base must be measured with extreme precaution, or the errors will accumulate from one triangle to the other.

113. It is almost impossible to measure the base with absolute accuracy. It is very short compared to the extent of country to be plotted, and is one of the sides of the first triangle, which is connected with a second, and this last with a third, and so on, each triangle increasing a little. When they are nearly equilateral, the accumulation of error is avoided and the results may be relied on. But when the operation is finished it is necessary to test its accuracy. This is done by measuring another base, far away from the first, and forming one of the sides of a triangle. If the triangulation is exact the measured length of the side of the triangle will correspond to the length obtained by calculation.

The longitudes and latitudes of the stations and the azimuths of the sides of the triangles form another means of verifying the accuracy of the triangulation. These angular values being determined at one station by astronomical observations, we find what they are at another station by calculating the position of the intervening stations in succession. The astronomical observations are repeated at the station to be verified, and a comparison of them with the calculated position of the station indicates the errors if any, and the compensation to be made for them, without, however, invalidating operations absolutely correct.

Laplace has demonstrated, that it is better to use as few triangles of the first order as possible; and that they should be of as large dimensions as the localities and the power of the telescopes admit.

114. The *signals* should be established in such a manner as to be seen with distinctness a great distance. Vertical stakes and reversed cones are excellent for this purpose. Steeples, spires, towers, &c., should only be used when the observer can place himself at them to observe with facility and especially with stability; and care should always be taken to project the axis of the signal on the ground so as to leave no uncertainty of its position. Trees without branches, and mills, may be used for triangles of the third order, because the errors resulting from them are not propagated.

The best signal is a circular iron plate with a hole in the centre. It should be fitted to a vertical rod, around which it revolves, so as to present its face to the neighbouring stations in succession.

A small quadrangular pyramid stuck on the top of a staff is also frequently used as a signal.

It was thought that Bengal fire and reverberating parabolic reflectors would be useful for nocturnal observations, as a means of employing time in foggy weather. But it has been abandoned; the horizon is never sufficiently clear at night, and terrestrial refractions increase the causes of uncertainty.

115. A signal can be seen better when projected on the sky than on the ground or the trees. Then, being stationed at A (fig. 57) it is easy to ascertain if the signal there will be seen from B, projected against the sky without going to B. For example take the zenith distance of B and that of the mountain C directly opposite, that is the angles  $B A Z$ ,  $C A Z$ ; the point C falls above or below the direction  $A B I$  according as the sum of these angles is greater or less than  $180^\circ$ . Thus we will elevate the signal A until  $B A Z + C A Z$  is greater than  $180^\circ$ .

All the signals projected against the sky should be painted black, and those against the ground or the forest white.

When no building can be had, which will answer the purpose both of a signal and a shelter to the engineer, it is frequently necessary to erect a temporary observatory. It is made in the form of a quadrangular pyramid truncated near the summit. (Fig. 64). A staff S in the axis serves as a signal, and the observer places his instrument at the point C, the horizontal projection of the axis. The pyramid is made of wood, and roofed to within about six feet of the ground. A cloth stretched on the windward side completes the shelter. When the observations are completed, the pyramid is removed, and a square monument firmly planted at C, with two diagonal lines drawn on it intersecting each other in the axis of the signal.

Subsequent verifications require these stations to be revisited, and the monuments thus fixed form indisputable evidence of their locality and are easy to find.

When a signal is erected, it should be sufficiently high to be seen from the neighbouring ones. It is ascertained by experiment that it should be seen at least under an angle of  $31''$ ; and as the  $\text{tang. } 31'' = 0.00015$ , the height A B (fig. 56) of the signal being A B = A C  $\text{tang. } C = A C \times 0.00015$ , we see that it is necessary that this height should be at least fifteen times the hundred thousandth of its distance from the observer. If this distance is the usual one which is about 20,000 metres (21,900 yards) the signal should be more than 3 metres (9.842 feet) high. In the French triangulation the signals were given an elevation of one seven thousandth of the distance they were to be seen.

117. It frequently happens that the signal A seen from stations B and C (fig. 65) is not a fit one to observe from. It is then necessary to place the instrument in its vicinity, for example at O, and measure the angle B O C =  $\theta$ , and then make the corrections to reduce it to the angle B A C = A, the angle that would have been obtained if the instrument had been stationed at A. This is called *reducing the angle to the centre of the station*. The three sides of the triangle A B C, which we call  $a, b, c$ , are supposed to be known, approximately at least.

We will first suppose the case of the triangle B A C where the point O is in the direction of the side B' A. Draw O E parallel to A C, and make A O =  $m$ , and the angle A C O =  $\epsilon = C O E$ . The angle B' O C, is known, and it is required to find the angle A =  $\alpha + \theta$ . Then the triangle C A O gives

$$\frac{\sin. C}{m} = \frac{\sin. \alpha}{AC} \text{ whence } \sin. C = \sin \theta = \frac{m \sin. \alpha}{b}$$

As  $m$  is always very small in relation to  $b$ ,  $\sin. \theta$  is very small and



may be replaced by  $\theta$ , or rather by  $\theta \sin. 1''$ , as  $\theta$  expresses the number of seconds in the arc. Thus

$$A = a + \frac{m \sin. a}{b \sin. 1''}$$

Now if the triangle is  $A B C$ , where the station  $O$  is not in the direction of one of the sides of the triangle, we have

$$B' A C = a + \theta = a + \frac{m \sin. a}{b \sin. 1''}$$

$$B' A B = a' + \theta' = a' + \frac{m \sin. a'}{c \sin. 1''};$$

$$\text{then } A = O + \frac{m}{\sin. 1''} \left( \frac{c \sin. a + b \sin. a'}{b c} \right) . . . (1)$$

In the application of this formula, it is necessary to bear in mind that when the station is so placed that either one of the angles  $\theta, \theta'$  falls on the other side of the line  $A C$  or  $A B$ , the angle then should be subtracted from  $O$ . Thus, the two expressions  $c \sin. a, b \sin. a'$  are both positive, only when the station  $O$  is within the angle  $p A q$  formed by the prolongation of the sides of the triangle. When it is situated in the angle  $B A C$  they are both negative, and when  $O$  is placed in the angle  $C A q$ , or the angle  $B A p$ , as in figure 63, they are of contrary signs.

118. This last is the most favorable position for reducing the angle, and it sometimes happens that the two terms in equation (1) destroy each other and there is no correction to make. This takes place when  $c \sin. a = b \sin. a'$  whence

$$\frac{\sin. a}{\sin. a'} = \frac{b}{c}; \text{ then we have } \frac{b}{c} = \frac{\sin. B}{\sin. C} = \frac{\sin. (A + C)}{\sin. C},$$

and  $A = a - a'$ ; from which we find  $a = A + a'$ ,

$$\frac{\sin. (A + c)}{\sin. c} = \frac{\sin. a}{\sin. a'} = \frac{\sin. (A + a')}{\sin. a'},$$

Developing this equation and making the reductions, we have

$$\frac{\sin. A \cos. C + \sin. C \cos. A}{\cos. C} = \frac{\sin. A \cos. a' + \sin. a' \cos. A}{\sin. a'}$$

whence  $\cos. C = \cos. a'$ .

Thus the observed angle  $O$  requires no correction to become  $A$ , whenever  $C = a'$  or  $180^\circ + a'$ . In this case the quadrilateral  $A B C O$  can be inscribed in a circle, because the angles  $B C A$  and  $B O A$  have the same measure in the circle circumscribing the triangle  $A B C$ . The station  $O$  can then be chosen so as to fulfil this condition.

119. But it is seldom this case presents itself, and in all others the angle  $O$  must be reduced by equation (1). This equation is adapted

to the use of logarithms in the following manner : The triangle A B gives

$$\frac{b}{c} = \frac{\sin. (A + C)}{\sin. C};$$

and  $O = a' + a$  may be regarded as equal to A; thus  $a = A - a'$ . By substituting these values in equation (1) it becomes

$$A = O + \frac{m}{b \sin. 1''} \left[ \sin. (A - a' + \frac{\sin. (A + C) \sin. a'}{\sin. C}) \right]$$

Reducing this expression to the same denomination, &c., it becomes,

$$A = O + \frac{m \sin. A \sin. (C + a')}{b \sin. C \sin. 1''} \quad . . . . . (2)$$

This expresses *in seconds* the correction to be made in the angle B O C to make it equal to B A C.

120. When the signal is in the axis of a cylinder, the centre A cannot be seen from O. It is then determined by drawing lines tangent to each side of the cylinder, and bisecting the angle. Thus we measure the angles B O l', B O l (fig. 70) and the mean between them is the angle B O k' = a.

In getting the distance O A = m, if we cannot measure directly the radius A k = r, we measure O k = i = m - r, and also one of the tangents O l = t = O l', we will then have

$$O l^2 = O A^2 - A k^2 \text{ or } t^2 = m^2 - r^2 = (m + r) i.$$

This equation gives  $m + r = \frac{t^2}{i}$ ; and as  $m - r = i$ , by adding these equations we get  $2 m = i + \frac{t^2}{i}$ ,

It may be proper to observe that, as the terms containing a and m express very small quantities, it is not necessary to have their values very exactly; moreover, as the use of the above problem does not suppose great accuracy, we are authorized in taking A = O.

[TO BE CONTINUED.]

*Notes on Belgium.* By CAPTAIN G. W. HUGHES, *United States Topographical Engineer.* Addressed to FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

[CONTINUED FROM PAGE 164.]

Steam engines are made at Liege, Seraing, Brussels, Molenbeck, Gilly, Tirlemant, Bruges, and Namur. From 1829 to 1835, there were 261 steam engines of 5,400 horses power, built at Liege, since which time the numbers and power have nearly tripled.

Nail making is also a very important branch of industry connected with the mineral productions of this country. The principal factories

are at Liege and Charleroi, at which latter place there are 5,500 workmen constantly employed.

The reputation of the arms fabricated in Belgium is now well established. The principal seat of this branch of industry is at Liege, which numbers, within its jurisdiction, more than fifty manufactories, and most of them in a highly flourishing condition. These products are exported to South America, Egypt, Turkey, Germany, Italy, Spain, and even the United States, where, it is said, they are preferred to the Birmingham arms. Be this as it may, it is a well known fact that gun and pistol barrels, and locks, are sent to England, where they are mounted and *marked*, and sold for *three times* the Belgian prices; but this is owing somewhat to the superior style in which they are finished in England. It is estimated that more than 30,000 stand of arms are annually exported to the Brazils. The following table shows the amount of this species of manufacture for 1836, (the last official statement I have been able to procure,) since which time it has *greatly* increased, and perhaps nearly doubled.\*

|                                                 |              |
|-------------------------------------------------|--------------|
| Sporting guns, (single barrel,) - - -           | 152,044      |
| “ “ (double barrel,) - - -                      | 24,846       |
| Boarding muskets, (for ships,) - - -            | 8,438        |
| Holster pistols, per pair, (for Cavalry,) - - - | 22,086       |
| Pocket pistols, per pair, - - -                 | 70,314       |
| Muskets for Infantry of the Line, - - -         | 71,651       |
| <hr/>                                           |              |
| Total of all kinds, - - -                       | 349,379      |
| Estimated to be worth - - -                     | \$ 1,400,000 |

I have no where seen rifles, (*un fusil rayé*), mentioned in the returns of arms; yet almost all their *case* pistols are rifled, but so far as I can learn, the American rifle is not much used, and its fearful and deadly qualities, as an offensive weapon, not well understood. The Belgian officers have been not a little astonished (and somewhat incredulous I have thought,) at the accounts I have related of the feats with this arm of some of our Western back woodsmen.

The country embraced between the French frontier and an imaginary line drawn from Ostende to Arlon, comprising the Province of Liege, abounds with building materials, such as marbles, of different kinds, granite, slate, freestone, and lime, of different qualities, including the *hydraulic*, which is much used as a stucco for the exterior covering of houses.

The provinces of Hainault, Namur, Liege, and Luxembourg, con-

\* There are more arms manufactured in Liege alone, than in the whole of France; and it even exceeds, in this respect, Birmingham, which is regarded as the great armory of England.



tain many *marble* quarries; the most important of which are in the cantons of Beaumont and Chimai, near Fontaine l'Eveque, Bouvigne, near Rochefort, at Dinaut, St. Medard, and Lesves—the neighbourhood of Phillipeville presents many varieties of them; the black marble of Dinaut is particularly recherché.

The best and most beautiful *slates* (perfectly free from iron pyrites,) are found in the provinces of Namur and Luxemburg. The quarries of Herbeumont are the most important, and yield over 8,000,000 per annum. They sell at the quarry, when well dressed, for about \$3 per thousand.

Excellent building stones, and lime stones, occur in the provinces of Namur, Luxemburg, Liege, Limburg, Hainaut, and Brabant. The blue lime stones (*les pierres bleues*,) found in the vicinity of Dinaut, and at Soignies, are much esteemed.

The most beautiful building stone in Belgium, is the blue carbonate of lime, already mentioned as the *pierre bleue*, of a fine and compact grain. It is easily cut, and is susceptible of a good polish. It resists the action of air, water, and frost; and is quarried in large blocks, sometimes sufficiently massive to make columns of a single piece, from twenty to twenty-five feet in height. The better kinds of this rock are in much demand throughout the kingdom, and much of it is transported to Holland. It is used in Brussels for the basements, pillars, stair-ways, lintels, and cornices of houses, and for the trottoir of streets, etc. The other portions of the structure are usually built of either bricks, or of a whitish brown free stone, called *grés*, found in the neighbourhood. It is rather soft when first quarried, cuts easily, and indurates on exposure to the atmosphere. This stone is usually worked in small regular pieces, and when well dressed, forms a handsome façade. The beautiful metropolitan church of St. Gudule, and the celebrated Hotel de ville de Bruxelles, are both being restored with this material; and the partial restoration of the lofty, rich, and towering spire of the latter is already very agreeable to the eye, and cannot fail to produce, when completely finished, a most striking effect. It is highly creditable to the Belgians that, since the revolution, which gave them for the first time since the days of Cæsar, a separate and distinct rank amongst the nations of the earth, the work of restoring the ancient architectural monuments of the country has been carried forward in a spirit of patriotism, liberality, and good taste. This stone, *le grés*, unites quickly and strongly with mortar; and the *pierre bleue* is occasionally used as a hydraulic cement.

The blue lime stone of Nivelles, although of the same sub-species with the foregoing, is inferior to it in quality.

This same kind of rock is also found on the banks of the Meuse,

between Namur and Huy; but it cracks and scales off more readily than the Soignes stone, and, when quarried in the winter, does not well resist the action of frost.

The lime obtained from this stone, mixed in equal proportions with sand, and a little hair, constitutes the usual stucco used in Brussels, where *every house*, except those built exclusively of stone, is covered by it. This cement certainly resists the action of the atmosphere most admirably; and the universal practice of plastering the houses, or white-washing them, gives to "Belgium's ancient capital" an air of neatness and lightness but seldom seen in European towns. The best composition for this purpose is a mixture of the cendrie de Tournay and sand, and occasionally a small proportion of common lime. The Tournay cinders are a powder formed by half burning a hard blue limestone, found at Tournay, the debris of which falls through the furnace grates, and is mixed with the (mineral,) coal ashes. This is said to be quite equal to the *Dutch Terrasse*, and is employed for the same purposes. And indeed the Terrasse of Holland, the cinders of Tournay, and the powder of well baked earthen tiles, may be regarded as artificial Puzzolanas, which acquire by heat, the property of solidifying under water.

The *Terrasse de Hollande* is a species of argillaceous earth found near Cologne. It forms, when baked, ground to a powder, and mixed with common lime, a capital cement, which alike resists humidity, dryness, and the extremes of temperature.

Besides the afore-mentioned substance, there is another much used in Holland, and in some parts of Belgium, called Trass, which is a species of lava, and is undoubtedly of volcanic origin. It is divided into two classes; the first is the soft stone of Andernock, (le moellon d'Andernock,) quite fragile, and of a whitish gray colour; the second is known as le moellon de Boul, harder than the first, and of a deeper gray colour, yielding, when ground, a kind of puzzolana which produces, when mixed with an equal quantity of fat lime, a very indurated mortar, perfectly impervious to water. The hardest of these moellons are selected for the most important hydraulic purposes, such as dykes and subterranean structures, where it is necessary to prevent the infiltration of water. For ordinary works, the two kinds of powder are mixed in equal proportions, and this forms the article generally known in commerce as "*Andernock*," which is the name of the town where it is found, not far below the junction of the Moelle with the Rhine. This material is much used for building in the towns on the Rhine and its tributaries.

For the exterior covering of the walls of buildings, the hydraulic

lime of Tournay is commonly used in Brussels, and the mortar is generally composed of the following constituents.

1st. One cubic yard of lime, in paste.

2nd. One and a half cubic yards of sharp sand.

3rd. Fifty pounds of short hair, as it is scraped from hides in dressing them.

These three substances should be well mixed and ground together, and no more water added than may be necessary, to render the mortar tolerably thick and pulpy.

The sand is employed in the condition in which it is taken from the pits, except that it is passed through a rather fine wire seive, to get rid of the small stones, or coarse gravel.

The stucco usually consists of three coats, or layers, each layer being about five millimetres, or a little less than two-tenths of an inch thick; making the whole thickness of the plastering about one-half inch.

After having wet the walls, in order that the mortar may the more readily adhere, the first coat is quickly applied with a trowel. This first layer is called *cripis*, because it produces an extremely rough surface. When the *cripis* has been perfectly dried, the second coating is laid on, and should be well dressed and smoothed with a ruler, or straight piece of board; and when the cement has acquired a certain consistency, the third and last layer is applied, and carefully dressed and trimmed with a trowel.

The cost of this kind of composition, including materials and labour, is, per square yard, sixty centimes, or about 11½ cents.

The interior walls of houses are plastered in the same manner, and with the same kind of cement, except that *walloon lime* and *fine sand* are employed; and as this lime is much fatter than the hydraulic lime it neutralizes a greater quantity of sand. A mixture of one cubic yard of lime with two cubic yards of fine sand makes an excellent mortar. The price per square yard, of this kind of work, everything included, is fifty-five centimes, or about 10½ cents of our money.

The price of a cubic yard of Tournay hydraulic lime, in Brussels, is about

|   |                                                                        |   |   |   |         |
|---|------------------------------------------------------------------------|---|---|---|---------|
| - | -                                                                      | - | - | - | \$ 4,00 |
| " | of Tournay cinders, per cubic yard,                                    |   |   |   | 4,50    |
| " | of Walloon lime, -                                                     | - | - | - | 5,25    |
| " | of the pierre bleue, when well cut and chisel dressed, per cubic yard, |   |   | - | 20,00   |

To which must be added per square yard of surface,  
cut to mouldings, - - - 4,12½

I deeply regret not having been able to procure the analyses of their various building substances, but it is extremely difficult to ac-



quire information of this kind in Belgium; and indeed the analyses of minerals would seem not to have excited much interest among the savans of this country.

Mill-stones, grind-stones, flints, and whet-stones, have been long known in Luxemburg and Liège; the grind-stones quarried at Nilsalm are among the very best in Europe, and there are about 80,000 of these stones, some of very large size, dressed each year for market; and many of them are sent abroad.

The province of Namur furnishes a very good kind of clay, adapted to the manufactory of Delft ware, potter's ware, and pipes. There is also a very considerable sand bank in Ardennes, which produces an excellent metal for porcelain.

Our Minister to Brussels, Mr. Maxey, having procured general letters to the industrial establishments of this country, from Mr. Mieus, (a Director of the *Société Generale*, the great Bank of Belgium, which is connected with nearly all of the large manufactories of the kingdom,) I recently, in company with that gentleman, made an excursion to Charleroi, an important frontier town on the Sambre, for the purpose of examining the productive works of that rich mineral and manufacturing district.

It may be proper to remark that a good deal of caution is observed in admitting strangers to visit manufactories in Europe; and indeed without an order from an officer, or from some person connected with those establishments, it is difficult, if not impossible, to gain access to them; and letters of introduction, for such purposes, are not easily obtained.

We first went to the iron works of Couillet, near Charleroi. They belong to a chartered company called "*la Société anonyme de Couillet pour la fabrication de fer.*" Almost all the works of this kind are joint stock concerns, and when so are usually designated as the Anonymous Society of a certain place, for a specific purpose; and these companies are placed under the *patronage* (as it is called,) of some great Banking Institution, through the agency of which they transact their financial business. The *Observateur*, a Brussels newspaper, has recently published "a table of the different administrations confided to Count Mieus, (Governor of the *Société Generale*,) the funds of which represent a capital of 233,520,100 francs;" this capital is divided among seventeen financial and industrial Societies.

The iron works of Couillet are truly magnificent, covering more than eleven acres of ground. All the structures are well built, and exhibit a good deal of taste, as well as skill, in their designs.

This establishment contains eight blast furnaces, (*hauts fourneaux*,) only one of which is at present in activity; and at no time have there

been more than five in operation, owing to the falling off of the iron trade since 1837, (the most of the furnaces having been erected subsequently to that year,) which would have proved still more embarrassing to the iron masters, but for the demands of the government for railway purposes; which were, to a certain extent, anticipated, for succeeding years, in order to lessen the check to this branch of industry. There are twenty-two blast furnaces in the immediate vicinity of Charleroi, but the half of them are not in use at present.

The furnaces at Couillet are forty-five feet high, and fifteen feet across the boshes. The blast is usually hot, and it requires an engine of sixty horses power to work one furnace. With the hot blast the following is the charge.

|               |   |   |   |             |
|---------------|---|---|---|-------------|
| Ore, -        | - | - | - | 40 buckets. |
| Coke, -       | - | - | - | 34 “        |
| Lime-stone, - | - | - | - | 24 “        |

With the cold blast the ore is diminished to thirty buckets, while the other substances remain constant.

The materials for the charge are elevated by buckets attached to an endless chain, which passes over two drums, the one at the top, and the other at the foot of the stack, between the two furnaces, and is moved by the steam engine which keeps up the blast. Each furnace yields from ten to twelve tons of pig metal per day. The hearths are built of fire brick, (made at the works,) and last from five to eight years. The coal is found close at hand, but cannot be used to advantage for reducing ores, until coked, which process is here conducted in ovens, of which there are a great number.

In Wales the coking is usually done in the open air, very much in the way wood is carbonized in the United States, by covering it with earth; but this is a wasteful mode of operation. The coal about Couillet yields from sixty to seventy per cent. of coke—the first for the refineries and the second for the blasts. The deepest coal pits in this district are from 900 to 1200 feet below the surface. The best coal is taken from a bed four and a half feet thick. They find but little iron ore with the coal, and those used are the limonites, brought from a distance of three or four miles, and yield from thirty-five to forty-five per cent. of metal. Sulphuret of lead is sometimes found in considerable quantities with the iron ore.

The rolling mills and forges are very extensive, and embrace the latest and most approved English and German improvements.

An engine of sixteen horses power moves two immense trip hammers at the same time; they are kept in motion by a large revolving cylinder with cogs; and as these cogs trip the hammers, they fall on

the heated metal below. With these hammers they have forged masses of metal weighing 4000 lbs. The best metal is made in this way, and is not rolled, except once, when taken from the puddling furnaces. When very strong iron is required, several bars are heated, and welded together, by these ponderous hammers; the *best* quality of iron brings, at this time, 400 francs per 1000 kilogrammes, or about \$80 per ton. With the hammers are connected two enormous pairs of shears, which seem to meet with scarcely any resistance in cutting through rods of iron of two and a half inches diameter.

We went next to the machine shop for the fabrication of steam engines, screws, tools, &c., used for turning and planing castings. We here noticed a large mortising machine (for cutting mortises out of cast iron,) made by Sharp, Roberts & Co., of Manchester. An engine of twenty horses power is connected with this shop. It is proper to remark that all the steam engines employed in these works were made here: They are of the English form, and perform well. It is but just to the Belgium manufacturers to say, that whatever they *do* they do *faithfully*; in illustration of which I will mention that the minister of public works, in his report for 1840, states that not a single accident, producing any serious personal injury, occurred during that year, amongst the numerous steam engines in constant use; of which, I think he said, there were between 11 and 1200.

The foundry is also extensive, and the arrangements are adapted to the casting of very large pieces. The day of our visit they cast an iron plate for the Oignies glass works, of the following dimensions: 18 feet  $\times$  10 feet  $\times$  0.5 feet. It is quite difficult to cast so large a plate smoothly, and without flaws, and the first effort is seldom successful. The *form*, or *mould*, is prepared with bricks carefully laid, and then covered with a composition of sand, clay, and coke, hard rammed, and made as smooth as possible. The melted metal is run from the furnace into iron pots, connected with cranes, by which they are moved. When full, these pots weigh 1200 lbs., and are easily manœuvred by one man. It is essential to the success of the operation that the melted iron should be poured into the mould *precisely* at the very same time from all the pots, and from, at least, four different directions, else the several currents of metal will not perfectly unite. Another necessary precaution to be observed, is to guard against the danger of an explosion of the steam beneath the form, generated from the moisture, which it is found impossible completely to expel. To remove this difficulty, iron pipes, to carry off the vapour, are laid, in an inclined position, with one orifice under the mould, and the other exposed to the air. As soon as the plate becomes solid it is covered with sand, and left to cool slowly, which takes five or six days. It



is then planed quite smooth before it can be used for its destined purpose, the casting of large plate glass for mirrors.

In the rolling mills are two steam engines, respectively of sixty and eighty horses power. They were rolling arched rails for a Siberian railway, while we were present, of forty-four pounds to the yard. The iron, after being refined, is puddled, rolled, welded, and rolled four times, before it is carried to the pattern roller, and passed seven times through them before the process is completed. The railway chairs which we saw cast weigh eighteen pounds each.

There are 450 men employed in these works, exclusive of those engaged in the mines, and in transporting the raw materials. Some of the work is paid for in proportion to the quantity, but most of the workmen are hired by the day, their wages varying from two to three francs.

TO BE CONTINUED.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Cost of Excavating Earth, by Means of Scrapers, or Scoops.*  
By ELLWOOD MORRIS, Civil Engineer.

Of all machines known to American Engineers, and used upon our public works for the excavation of earth, and its removal to short distances, the *scraper, or scoop*, is, within its proper sphere of influence, by far the most economical.

This instrument is particularly well known to Canal Contractors, much used by them in earth cuttings, and most frequently employed in excavating the trunks of canals, where they are so laid out that the cutting makes the bank, or nearly so; but the *scoop* may be used with success in all excavations of earth where the slopes do not exceed  $1\frac{1}{2}$  to 1, if the material to be taken out yields readily to the plough, and is not required to be moved horizontally more than 100 feet, nor to vertical heights exceeding 15 feet; there are doubtless instances where both these limits may be surpassed, and the use of the *scoop* still be highly economical, but such cases are not general, and the practical scope of the utility of *scoops* may be regarded as confined to the excavation of canal trunks, and the formation of low road embankments from side trenches, for both of which purposes it is most admirably adapted.

This machine is drawn by two horses, managed by a boy, and usually requires the ground to be first ploughed; then by simply elevating and guiding the handles a little, the driver causes it to load itself, for the horses being in motion it turns in its clevises, and inclining downward, runs under the loose dirt like a plough; the handles being released, the loaded *scoop* moves upon two iron shod runners

which form the sides, and project below the bottom, and finally after reaching the place of deposit, the handles being smartly elevated, the edge of the *scoop*, which is armed with iron, takes hold of the bank, and the horses moving on, it overturns and discharges its load; in this overturned position, with the handles resting on the double tree, it returns upside down to the place of excavation, and is there loaded, &c., as before.

Although for successful scooping the ground usually requires loosening, and must not be so hard as to resist the plough; it is often the case, especially in sandy material, that it is so soft that the scoop, by its armed edge, is able to excavate it, and load itself, without any previous loosening of the earth.

All this will be rendered so evident to the reader, by an inspection of the annexed isometrical sketch, showing *a scoop*, with its double tree, and single trees, that any further description of the mode of operation seems to be entirely unnecessary.

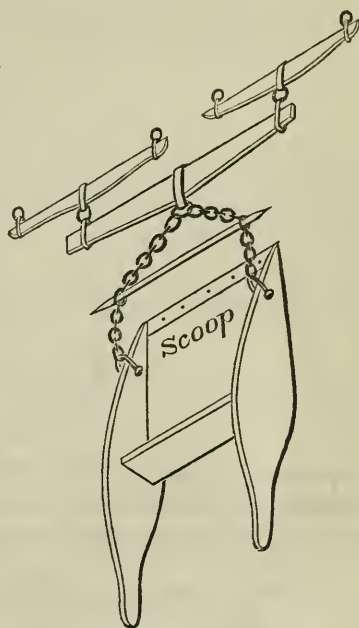
The writer pursuing his object of acquiring, from actual experiment, a knowledge of the cost of excavating materials and forming embankments upon public works, early addressed himself to observe the effect produced by scoops, and the results of numerous observations upon scooping earth to horizontal distances of from 30 to 80 feet, and heights of 5 to 15 feet, where the slopes are 2 feet base to 1 foot rise, established in a satisfactory manner the following data:

1. That taking average earth (yielding readily to the plough,) at mean stages of weather and seasons, *a scoop load* may be taken at *one tenth of a cubic yard measured in excavation*.

2. That the time lost in loading, unloading, and all other ways, per load (except in turning,) is, at an average, *two-thirds of a minute*.

3. That in every complete turn, or semicircle, described by the horses, *one-third of a minute is lost*.

4. That if the mean horizontal distance of transportation of the earth in a right line, *be added to the extreme height scooped, measur-*



ing vertically from the bottom of the excavation to the top of the bank, then for every 70 feet of this aggregate distance, *one minute* will be consumed by the horses in going out and returning back.

5. That if the earth be all scooped to *one side*, as for instance, to the tow-path bank alone, of a canal, *two turns, or a complete circle*, will be made by the horses, for every load deposited in bank.

6. That if the earth be scooped to *both sides* of a canal, but *one turn, or a semicircle only*, will be described by the horses, for each load put in bank.

From the 5th and 6th observations, it follows that clear of the time needed to overcome the horizontal haul and vertical height, the constant amount of time lost per load, will be:

*In Double Scooping*.—Time lost in loading, &c., =  $\frac{2}{3}$  minutes.

Do. in turning *once*, =  $\frac{1}{3}$  “

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Total, - - = 1 “

*In Side Scooping*.—Time lost in loading, &c., =  $\frac{2}{3}$  minutes.

Do. in turning *twice*, =  $\frac{2}{3}$  “

---

Total, - - =  $1\frac{1}{3}$

Now if the sum of the mean horizontal haul, and the extreme height scooped, both in feet, be put - - =  $a$

The number of hours wrought per day, - - =  $b$

The number of cubic yards excavated and placed in bank, per day, by each scoop, - - =  $x$

Then the general formula to find  $x$  in *double scooping* will be:

$$\frac{\left( \frac{60}{\frac{a}{70} + 1} \right) b}{10} = x.$$

Transforming this equation by the rules of algebraic fractions, and substituting for  $b$  the average number of hours commonly wrought per day, = 10, we are able to reduce the formula to the following:

$$\text{In Double Scooping, } \frac{4200}{a + 70} = x \quad . \quad . \quad . \quad \text{I.}$$

And for *side scooping* the general formula will be:

$$\frac{\left( \frac{60}{\frac{a}{70} + 1\frac{1}{3}} \right) b}{10} = x.$$



Transforming which, by the rules of algebraic fractions, we have:

$$\text{In Side Scooping, } \frac{4200}{a + 93\frac{1}{3}} = x \quad . \quad . \quad . \quad . \quad \text{II.}$$

Now putting the cost per cubic yard of excavation put in bank clear of all profit, - - - - - =  $y$

The daily wages of a scoop and driver, in cents, =  $c$

The cost per cubic yard, in cents, of loosening the earth, =  $d$

The formula to find  $y$ , the cost in cents per yard, either in double or single scooping, will be:

$$\frac{c}{x} + d = y \quad - \quad - \quad \text{III.}$$

The actual number of cubic yards excavated and put in bank by scoops, in several instances, having become accurately known to the writer, the correctness of the formulæ I and II will be tested by those cases.

*Example I. Double Scooping.*

In this case, 3600 cubic yards of earth were excavated and put in bank by 90 days work of scoops, or per scoop, per day, = 40 cubic yards, - - - - - =  $x$

The mean horizontal haul was =  $26\frac{1}{2}$  feet.

The extreme height scooped, = 8

Aggregate distance, - - - =  $34\frac{1}{2}$  =  $a$

Then by the formula I we have:

$$\text{I. } \frac{4200}{a + 70} = x \text{ or } \frac{4200}{34\frac{1}{2} + 70} = \frac{4200}{\frac{209}{2}} = \frac{8400}{209} = 40\frac{2}{10} \text{ c. yds.} = x.$$

Here the calculated and actual days work of the scoops is the same within  $\frac{2}{10}$  of a cubic yard.

*Example II. Single or Side Scooping.*

In this case, 5000 cubic yards of earth were excavated and deposited in bank by 176 days work of scoops, or per scoop per day, =  $28\frac{1}{2}$  cubic yards, - - - - - =  $x$ .

The mean horizontal haul was = 44 feet.

The extreme height scooped, = 11 "

Aggregate distance, - - - = 55 - - - =  $a$ .

Then by the formula II we have:

$$\text{II. } \frac{4200}{a + 93\frac{1}{3}} = x \text{ or } \frac{4200}{55 + 93\frac{1}{3}} = \frac{4200}{\frac{445}{3}} = \frac{12600}{445} = 28\frac{3}{10} \text{ c. yd.} = x.$$

Here the difference between the real and calculated days work of a scoop is  $\frac{1}{3}$  of a yard.

Conceiving it to be unnecessary to display at length any more of the examples, we will embody, in the following table, the results of actual experiments, and compare them with those calculated by the formulæ.

| 1                  | 2                 | 3                     | 4                       | 5                                            | 6                                      | 7                                                                  | 8                                                            | 9                                                                                | 10                                                             |
|--------------------|-------------------|-----------------------|-------------------------|----------------------------------------------|----------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------|
| No. of experiment. | Kind of scooping. | Mean horizontal haul. | Extreme height scooped. | Value of <i>a</i> , or sum of cols. 3 and 4. | No. cub. yds. excavated & put in bank. | Days work of scoops employed in doing the work stated in column 6. | No. of cubic yards actually excavated per day by each scoop. | No. of cubic yards excavated per day per scoop; calculated by formulæ I. and II. | Cost per cub. yd. of the excavation calculated by formula III. |
| 1                  | Double.           | 26 $\frac{1}{2}$      | 8                       | 34 $\frac{1}{2}$                             | 5000                                   | 126                                                                | 39 $\frac{7}{10}$                                            | 40 $\frac{2}{10}$                                                                | 7 $\frac{8}{10}$                                               |
| 2                  | Double.           | 26 $\frac{1}{2}$      | 8                       | 34 $\frac{1}{2}$                             | 3600                                   | 90                                                                 | 40                                                           | 40 $\frac{2}{10}$                                                                | 7 $\frac{8}{10}$                                               |
| 3                  | Side.             | 44                    | 11                      | 55                                           | 5000                                   | 176                                                                | 28 $\frac{5}{10}$                                            | 28 $\frac{3}{10}$                                                                | 10 $\frac{7}{10}$                                              |
| 4                  | Side.             | 36                    | 6                       | 42                                           | 5610                                   | 181                                                                | 31                                                           | 31                                                                               | 9 $\frac{9}{10}$                                               |
| 5                  | Side.             | 40                    | 9                       | 49                                           | 852                                    | 28 $\frac{1}{2}$                                                   | 30                                                           | 29 $\frac{1}{2}$                                                                 | 10 $\frac{3}{10}$                                              |

In calculating column 10 of the above table, the hire per day of a *scoop and driver*, has been assumed to be 275 cents, and the cost of loosening, at 1 cent per cubic yard.

The near coincidence of the results in columns 8 and 9, shows how closely the calculated number of cubic yards, excavated per day, in each of the kinds of scooping, agrees with the real days work of *each scoop*, as actually ascertained in excavating 20,062 cubic yards of earth; consequently we may regard the formulæ which we have deduced, as being sufficiently confirmed to justify a full reliance upon them in practice.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Compression of Earth, and the Increase of Rock in Embankment, Compared with the Volume in Excavation. By ELLWOOD MORRIS, Civil Engineer.*

### I. *On the Compression of Earth in Bank.*

It is well known to practical engineers, that when earth is excavated and formed into embankment, it occupies *less space in bank* than in the cut whence it came.

Although experience has sufficiently established this fact, yet a contrary opinion is often entertained by persons who have not bestowed much attention upon such affairs; and this idea is encouraged by inadvertent paragraphs, which are sometimes met with in works of high professional authority.\*

Thus even in Professor Mahan's able treatise upon Civil Engineering, (page 118,) we find the following sentences:

"In determining the relations between the volumes of the embankments, and the excavations by which they are furnished, it must also be borne in mind that earth, in its natural state, occupies less space than when broken up; and as the embankments, when first formed, are in the state of earth newly broken up, an allowance must be made according to the nature of the soil. This allowance will generally vary between one-twelfth and one-eighth; that is, earth, when first broken up, will occupy from one-twelfth to one-eighth more bulk than it does in its natural state."

Now, so far from this being the case with embankments of earth, it is directly the reverse, and the fact is in practice, that the *compression*, and not the *expansion*, of earth, when formed into bank, is usually found to be from *an eighth to a twelfth part* of its volume in the natural state.

Although it is evident that a subject of this nature does not admit of a precise determination, because an almost endless variety exists in the consistency, and hence in the compressibility of earths; still it is quite possible to form an approximation which will not, in general, err very far.

A few years ago the writer made some observations upon embankments formed from excavations, in three different cases, and upon a tolerably large scale, where the accurate cubic content, both of cut and bank, was known, and the amount of the latter exceeded *thirty-nine thousand* cubic yards.

The details of these experiments, all of which refer to banks formed in layers by cart and scoop, are to be found in the following statement, of which we may further observe, that one winter intervened between the commencement and completion of each bank.

\* The most common error upon this subject, which we meet with in books, is the supposition that a certain amount of earth excavation, will form the same quantity of embankment; which, in practice, can never be the case in banks that are made with carts.

Thus in Professor Millington's excellent "Elements of Civil Engineering," we find it stated (at page 184,) that by a particular arrangement of levels, "one-half of the canal will be in excavation, and the remaining half in embankment, and the soil that is dug out of one end will serve to form the embankment at the other." The same idea runs through other works, which we might quote if it were necessary.



| Number of the embankment. | Earth excavated to form each embankment. | Embankment made by the preceding quantities of earth. | Shrinkage or compression of the earth in bank. | Rate of the compression of the earth in bank. | Remarks.            |
|---------------------------|------------------------------------------|-------------------------------------------------------|------------------------------------------------|-----------------------------------------------|---------------------|
|                           | Cubic yards.                             | Cubic yards.                                          | Cubic yards.                                   | Cubic yards.                                  |                     |
| 1                         | 6970                                     | 6262                                                  | 708                                            | $\frac{100}{984}$                             | Yellow clayey soil. |
| 2                         | 25975                                    | 23571                                                 | 2404                                           | $\frac{100}{1080}$                            | Ditto.              |
| 3                         | 10701                                    | 9317                                                  | 1384                                           | $\frac{100}{773}$                             | Light sandy soil.   |
| Total.                    | 43646                                    | 39150                                                 | 4496                                           | $\frac{1}{10}$ average compression.           |                     |

By these tabulated observations, we perceive that 43,646 cubic yards of earth, transferred from its natural locality into the embankment of a public work, suffered by the operation a diminution, or shrinkage, in bulk, of 4,496 cubic yards, or *one-tenth* of its mass.

Some other observations, upon a smaller scale, indicated that the compression which took place in *gravelly earth*, when used for embankment, amounted to about *one-twelfth* of its bulk in the cutting.

Consequently, at least until more ample experiments are made, these results seem sufficient to justify the assumption of the following rates for the *compression of earth in bank*,\* viz.

In light sandy earth,  $\frac{1}{8}$  of the volume in excavation.

In yellow clayey earth,  $\frac{1}{10}$  “

In gravelly earth,  $\frac{1}{12}$  “

In computations made for the purpose of equalizing the excavation and embankment upon roads, canals, or railroads, a strict attention to

\* As an example of the practical operation of these principles; suppose a contractor to have undertaken the formation of an earth cutting, and a contiguous embankment of greater amount, in which the earth excavation is to be used.

Let the amount of the earth cutting = 25,000 cubic yards at 25 cents per cubic yard.

“ Embankment = 40,000 “ at 30 cents per cub. yd. for that not from cut.

Then if we neglect the *compression of earth in bank*, there would be but 15,000 cubic yards of embankment not from excavation, and the amount of the contract would be,

25,000 cubic yards excavation of earth, at 25 cents, = \$ 6,250

15,000 cubic yards embankment, not from cut, at 30 cents, = 4,500

Total, = \$ 10,750

But as we have shown above, that the earth, when formed into bank, would, in fact, com-

the above considerations is indispensably requisite; for if they are neglected, it will be found that excavations, which have been laid out as sufficient to furnish the materials for a given embankment, will be deficient in quantity, and an unexpected resort to side cutting will become necessary to complete the bank, as has been witnessed by the writer in more than one instance.

In tracing out a canal, if the depth of cutting sought by the centre line, as necessary to form the banks from the excavation of the trunk, has been calculated without due allowance for *the compression of earth in bank*, the trunk of the canal will not supply material enough, and a resort either to cutting below bottom, or to side trenches, will become unavoidable, to make up the amount deficient.

## II. On the Increase of Rock in Bank.

By careful observations made by the writer, it was found that the excavation of 22,625 cubic yards of *hard sand-stone rock, which quarried in large fragments*, formed 32,395 cubic yards of embankment; showing that in this instance, the increase of the rock in bank was 9,770 cubic yards, or about *five-twelfths* of its volume measured in the cut.

In another case, it was noticed that the excavation of 16,982 cubic yards of *blue slate rock, that broke up into small pieces*, formed 27,131 cubic yards of embankment; showing that here the increase of the rock in bank amounted to 10,149 cubic yards, or nearly *six-tenths* of its measured bulk in the cutting.

From these observations, made upon the increase of near *forty thousand* cubic yards of rock-cutting carried into bank, it would seem that the augmentation was about *one-half*; but as in lime-stone, and other rocks, it might be found to vary, both with their relative fragility, and the dimensions of their quarried fragments, more ex-

press, or shrink, about one-tenth; the actual quantity of embankment which it would be necessary to supply *not from excavation*, would be as follows:

|                                                                  |                     |   |   |   |   |                       |
|------------------------------------------------------------------|---------------------|---|---|---|---|-----------------------|
| Gross amount of the bank,                                        | .                   | . | . | . | . | = 40,000 cubic yards. |
| Bank made from cut = 25,000 —                                    | $\frac{25,000}{10}$ |   |   |   |   | = 22,500   “          |
| Leaves embankment <i>not from cut</i> ,                          | .                   | . | . | . | . | = 17,500   “          |
| And the amount of the contract ought really to be,               |                     |   |   |   |   |                       |
| 25,000 cubic yards excavation of earth, at 25 cents,             |                     |   |   |   |   | = \$ 6,250            |
| 17,500 cubic yards embankment <i>not from cut</i> , at 30 cents, |                     |   |   |   |   | = 5,250               |
| Total,                                                           |                     |   |   |   |   | \$ 11,500             |

This last amount being \$ 750 *greater* than the former, shows how injuriously the interests of undertakers of works might be affected, if we failed to make due allowance, in calculating deficient embankment, for the *compression of earth in bank*.

periments upon this point appear to be necessary to enable correct rules to be framed.

*Philadelphia, September 1st, 1841.*

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*Railways in Germany.*—EMPEROR FERDINAND'S *Northern Road.*  
(*From Vienna to Bochnia, in Galicia, with Branches.*)

CONTINUED FROM PAGE 180.

The project for this railway, which is the most extensive as yet undertaken in Europe, was conceived already in 1830; from that time up to the year 1836, various local investigations, as well as an examination of the railways executed in England and Belgium, had been made by the banking house of Baron Rothschild, in Vienna, to whom, on application, the imperial privilege was finally granted, on the 4th of March, 1836, authorizing the formation of a Company of shareholders for the construction of a railway from Vienna, the capital of the Austrian empire, to Bochnia, in Galicia, with branches to Brunn, Olmutz, Troppau, Dwory, and Wielitchka. The provisions of this charter are of the most liberal nature; in regard to the right of way the same laws are to be observed as in the establishment of public turnpike roads by Government; no restrictions are made as to the tariff, and during fifty years no rival railway can be constructed between the above designated points. After fifty years the privilege expires, but may be renewed, the road and appurtenances remaining to the Company for ever.

Immediately after, an arrangement was entered into between the house of Rothschild and a provisory committee, formed by the first subscribers to the stock. Subscriptions were received for 6,000 shares (at £100,) which, with the 8,000 retained by the owner of the privilege, for himself and his friends, formed a capital stock of £1,400,000 (fourteen millions of florins.) This amount was deemed sufficient for the accomplishment of the work. The instalments were made at £10 every half-year, the first on the 30th of April, 1836, the last on the 15th of October, 1840; from the time of the first payment, made by the stockholders, they receive an interest at the rate of 4 per cent. per annum.

The charter provided that five miles of the railway were to be completed within two years, and the whole line to Bochnia within ten years from the day the privilege was granted. Accordingly, with the necessary means on hand, operations were immediately commenced, by making the surveys and plans for the section from Vienna to Brunn; the ground was first broken on the 7th of April, 1837, and the works prosecuted with the utmost vigour, from 10,000 to 12,000 labourers having been constantly employed on the line. Already, in November of the same year, the first trips were made to Wagram, a distance of seven miles; in August, 1838, nineteen miles of the railway were put into operation, and the whole line to Brunn, of ninety-one miles in length, was opened on the 7th of July, 1839, or in two years and three months after the commencement of the work. At



the same time the works in the main line towards Galicia were steadily progressing, and on the 1st of November, 1840, the following sections were nearly completed:—

|                                                          | Miles. |
|----------------------------------------------------------|--------|
| From Vienna to Lundenburg and Brunn, (opened,)           | 91     |
| “ Lundenburg to Hradish, (main line,) - -                | 30     |
| “ Near Vienna to Stockerau, (a branch,) - -              | 14     |
| <hr/>                                                    |        |
| Length of railway completed, or nearly so, - - -         | 135    |
| The following sections are in progress of construction:— |        |
| From Hradish to Prerau (main line,) - - -                | 30     |
| Branch to Olmutz, - - - - -                              | 15     |
| <hr/>                                                    |        |
| Total completed and in progress, - - -                   | 180    |

At the same time the surveys are now making for the other parts of the main line, and those branches yet to be constructed. The total length of the railway, with all its branches, will not fall short of 400 miles, which is certainly the greatest extent of any work of this kind yet undertaken in Europe by a single Company. The total amount already expended exceeds ten millions of florins, or one million sterling.

The railway derives its name from its traversing the northern provinces of the empire; amongst its principal objects is the transportation of oxen from Galicia to the Residence, the number of which, according to official data, amounts, annually, to more than 90,000. It will, in every case, contribute largely to develop the resources of those provinces, and become the more important by the connexion with the Warsaw and Vienna railway, now in progress. An uninterrupted line of railway will then exist between the Vistula and the Danube, connecting the Baltic with the Black Sea.

In the following a more detailed account is given of the construction, management, and operations of that part of the Emperor Ferdinand's Northern Railway, which has been for some time in use, viz. of the line from Vienna to Brunn, the capital of Moravia.

The railway commences at the Prater, a little distant rather from the centre, but still within the barriers of the city and suburbs. There is a spacious station, with extensive buildings for the passenger and freight departments, and for the repairing of engines and cars, destined to accommodate not only the line to Brunn, but of the whole railway. After leaving the depot, the railway crosses two arms of the Danube, by wooden bridges, which are both 1,960 feet in length. These bridges are built very light, in order not to put a permanent obstacle against the floating ice during the spring freshets, the accumulation of which might otherwise cause an inundation of the adjoining country. Having crossed the valley of the Danube, the line pursues a north-eastern course, and reaches the river March, which forms the boundary between Lower Austria and Hungary. After following, for a considerable distance, the course of this river, it crosses the Thaya at Lundenburg by numerous bridges. There, at a point

fifty miles from the city of Vienna, the branch road to Brunn parts from the main line, and follows the course of the Thaya and Shwarza until it reaches that capital, while the main line pursues its course in the valley of the March. The railway, although not very direct in its course, has, notwithstanding, several straight lines of considerable length, and the curves are all of very large radii. The whole distance from Vienna to Brunn is, as already mentioned, ninety-one miles.

The railway rises gradually towards the north, with moderate grades. The steepest inclination is nineteen feet per mile, and occurs only once for a short distance. The first nineteen miles of railway are graded for a double track, in order to accommodate a branch, which is to lead to Presburg, in Hungary; the remainder will only have a single track. The excavations and embankments were in some parts very considerable; the greatest height of the latter is thirty-eight feet. At Brunn the railway terminates upon a long viaduct over the valley of the Shwarza, consisting of eighty arches, seven of which have a span of thirty-one feet, the others of twenty-five feet. The total length is 2,383 feet. Of the works executed the following will give the best idea:—Excavations and embankments, 6,012,500 cubic yards, of which 140,000 cubic yards were excavation in solid rock. Length of wooden bridges, 3,708 feet; length of wooden bridges with stone abutments and piers, 488 feet; number of stone bridges and viaducts, twenty-four, with 228 arches; number of culverts, 116; of road crossings, 198; of which thirty-one are under, six over, and the remainder level, with the railway.

The superstructure is made as follows:—Cross ties of wood, formed of half trees of oak, larch, or fir, seven and three-quarter feet in length, and twelve inches in diameter, are laid three feet six inches from each other, upon a layer of gravel, twelve inches thick. Iron rails of forty pounds per yard, of the common T pattern, rest in chairs upon every sleeper, and are kept fast by iron keys, or wedges. The chairs used at the joints of the rails weigh fourteen pounds, the others, ten pounds. The width of the track is four feet eight and one-half inches. The rails were partly imported from England, and partly manufactured in Austria, but owing to the high freight and duty upon the imported rails, and to the inexperience in the manufacture of this article at home, the cost per ton of rails delivered to the road was in both cases not less than from £27 to £27½. The price of the chairs was £9 per ton.

Besides the principal station at Vienna, which was mentioned above, there is a similar large one at Brunn, and smaller buildings are on nine intermediate stopping places on the road, containing also cisterns, in which the water is heated before it is filled into the tenders. There are besides, along the line of the railway, eighty small houses, for as many watchmen.

For carrying on the transportation business the Company own now twenty-two locomotive engines, of which seventeen were built in England, two in Belgium, two in America, and one in Vienna. Of the engines constructed in England, twelve are from Messrs. Robert

Stephenson and Co., two from Jones and Co., two from Turner, Evans and Co., and one from G. and J. Rennie. All the English engines have six wheels, the driving wheels, as usual, in the middle. The two American locomotives were manufactured by William Norris, of Philadelphia; they are much smaller than the English, have also six wheels, but the driving wheels are behind, and the fore wheels supporting a truck, movable round a centre. These latter wheels are only thirty inches in diameter. Another engine is to arrive in a short time from Philadelphia, from the known manufactory of Messrs. Baldwin, Vail & Hufty, which has furnished, since 1832, over 150 engines for the American railroads, and two more engines are expected from Messrs. Sharp, Roberts and Co., of Manchester.

The passenger carriages used upon the railway are of three different classes, and built, as in England, all upon four wheels. The same is the case with the freight wagons; both carriages and wagons are built in the Company's own shops.

The following was the expenditure for the railway from Vienna to Brunn, up to the 1st November, 1839:—

|                                                                                    | £              | s.       |
|------------------------------------------------------------------------------------|----------------|----------|
| For preliminary surveys, &c., - - -                                                | 2,655          | 18       |
| Right of way, - - - -                                                              | 48,721         | 14       |
| Grading and bridges, - - - -                                                       | 136,070        | 18       |
| Superstructure: labour, - - - -                                                    | 38,603         | 0        |
| “ timber, - - - -                                                                  | 26,555         | 8        |
| “ iron, - - - -                                                                    | 167,274        | 5        |
| Turnouts and turntables, - - -                                                     | 3,917          | 16       |
| Station buildings, work-shops, watch-houses, furniture, utensils, and tools, - - - | 22,297         | 12       |
| Engines and carriages, &c., - - -                                                  | 40,510         | 9        |
| Cost of administration, - - -                                                      | 3,096          | 14       |
| Interest paid to stockholders, - - -                                               | 15,626         | 8        |
| <b>Total, - - - -</b>                                                              | <b>505,330</b> | <b>2</b> |

Since the 1st of November, 1839, there have been expended about £32,000 more, making the total cost of the railway, with buildings, locomotives, carriages, &c., equal to £537,000. This is for seventy-two miles of single, and nineteen miles of double track. This sum divided by ninety-one gives the average cost per mile of railway, with all appurtenances, £5,900, including also the interest on the capital of construction up to the time the line has been opened.

The chief engineers of the railway were Messrs. Ghenga and Bretschneider. On the opening of the whole line, the 7th of July, 1839, four trains, with 1,200 persons, started from Vienna, and reached the capital of Moravia in four hours. In returning, however, a sad accident occurred at one of the stations, by the concussion of two trains following each other too closely: several persons were more or less severely injured, much to the disappointment and grief of the Directors, who saw the festival end in such a melancholy manner. This and some further accidents, which may happen on every railway,



particularly in the first period of its operations, tended much to bring the undertaking into discredit amongst the public, and occasioned some severe measures and investigations on the part of the authorities.

The Vienna and Brunn railway is used for the transportation of both passengers and freight. The former are conveyed in three different classes of carriages, and pay for the whole distance, in

|                         |   |   |                           |
|-------------------------|---|---|---------------------------|
| Carriages of 1st class, | - | - | 12s. or 1.582d. per mile. |
| “ 2nd class,            | - | - | 8s. or 1.005d. “          |
| “ 3rd class,            | - | - | 6s. or 0.791d. “          |

Each passenger is allowed forty pounds of baggage; if the weight is greater, he has to pay at the rate of 0.42d. per cwt. per mile. Passengers may procure receipts for their baggage by paying 2d., and can, in such case, deliver the latter the day previous to their departure. If the baggage be lost on the road they can recover the amount of £2 10s. for a trunk, £1 10s. for a valise, and 10s. for a parcel; but may, if they choose, also insure the whole value of the baggage; the rate of insurance being one-tenth per cent.

In summer two trains are daily starting from each end of the line, one early in the morning, and one in the afternoon; in winter, one train from each end is sufficient. The passenger trains travel at the rate of twenty to twenty-three miles per hour, and perform the whole distance in from five to five and one-half hours, including stoppages at nine intermediate stations.

Freight is carried in extra trains, with an average speed of fourteen miles per hour. Passengers going with the freight trains pay two-thirds of the usual fare. The charges for freight are different, according to the specific weight and value of the articles; in the tariff all articles are divided into four classes, and the charges are, for articles of the first class, 1.9d.; of the second, 2.3d.; of the third, 3.1d.; and of the fourth, 3.9d. per ton, per mile: the average charge for freight is, therefore, 2.8d per ton, per mile. Parties preferring to load a whole wagon pay from 2s. 6d. to 3s., the load, in such case, not to exceed three and one-third tons. The Company guarantee only for such goods as have been insured by the proprietors; the rate of insurance is fixed at one-twentieth per cent.

The income of the road has been constantly on the increase since it was put into operation. In the year 1838, from April to October 31st, when only a small part of the line was in use, the income from passengers amounted to - - - £ 3,346 5s.

From 1st November, 1838, to 30th April, 1839, upon nineteen miles, the number of passengers carried was 58,143, the income, - - - 2,706 17

From 1st May to 7th July, 1839, the length of road in operation nineteen to fifty miles; number of passengers conveyed, 65,994, income, - - - 4,238 12

From 7th July to 31st October, 1839, the whole line in operation; passengers, 139,749; income, - 18,070 12

Income from freight, - - - - 704 3

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Total to 1st November, 1839, - - - £ 29,066 9

The revenue in the six months, from 1st of May to 1st November, 1839, amounted to £ 23,013 7s.; in the corresponding half year of 1840, the revenue was:—

|                          |   |   |   |          |       |
|--------------------------|---|---|---|----------|-------|
| From 144,354 passengers, | - | - | - | £ 26,163 | 18s.  |
| “ 18,616 tons of goods,  | - | - | - | 11,466   | 12    |
|                          |   |   |   |          | <hr/> |
| Total,                   | - | - | - | £ 37,630 | 10    |

This gross income is at the rate of fourteen per cent. per annum, on the capital of construction of £537,000.

The Directors have not yet published their report for the year 1840, from which the expenditure for managing the road could be ascertained for this last year. The following is an account of the expenditure for the period of six months, viz. from 1st May to 1st November, 1839. It is to be considered that the average length of railway in operation during this period was only 72 miles.

|                                                                                                    |   |   |   |          |       |
|----------------------------------------------------------------------------------------------------|---|---|---|----------|-------|
| For salaries to persons in the technical department,                                               |   |   |   |          |       |
| viz:—to engineers, assistants, and superintendents,                                                |   |   |   | £ 632    | 1s.   |
| Watchmen on the line and stations,                                                                 | - | - | - | 747      | 1     |
| Persons in the transportation department, viz., collectors, conductors, &c.,                       | - | - | - | 471      | 3     |
| Persons in the mechanical department, viz. superintendent of work-shops, engine, and firemen, &c., |   |   |   | 1,113    | 11    |
| Wages to men repairing railway,                                                                    | - | - | - | 531      | 14    |
| Traveling expenses, remunerations and damages,                                                     |   |   |   | 222      | 13    |
| Office expenses, printing, &c.,                                                                    | - | - | - | 699      | 16    |
| Equipments, utensils, requisites, &c. of persons employed in the different departments,            |   |   |   | 354      | 12    |
| House rent in Vienna and Brunn,                                                                    | - | - | - | 41       | 11    |
| Repairs of engines and cars,                                                                       | - | - | - | 1,719    | 12    |
| Oil, hemp, tallow, soap, candles, grease, &c.,                                                     | - | - | - | 736      | 10    |
| Torches and signals,                                                                               | - | - | - | 103      | 4     |
| Fuel: stone coal, and coke,                                                                        | - | - | - | 5,275    | 17    |
| “ wood,                                                                                            | - | - | - | 278      | 13    |
| “ oil cakes,                                                                                       | - | - | - | 10       | 17    |
| General expenses: administration, and some extraordinary charges,                                  | - | - | - | 720      | 8     |
|                                                                                                    |   |   |   |          | <hr/> |
| Total expenditure in six months,                                                                   | - | - | - | £ 13,659 | 3     |
| Recapitulation: income from 1st May to 1st November, 1839,                                         |   |   |   |          |       |
| “ expenditure ditto,                                                                               | - | - | - | £ 23,013 | 7     |
|                                                                                                    |   |   |   | 13,659   | 3     |
|                                                                                                    |   |   |   |          | <hr/> |
| Net profit,                                                                                        | - | - | - | £ 9,354  | 4     |

The expenditure amounted, therefore, to near sixty per cent. of the gross receipts, and the net profit was one and three-quarter per cent. of the capital invested, in the six months above mentioned. In the year ending 31st of October, 1840, the net revenue has amounted, probably, to at least six per cent. on the capital expended.

The reason of the great expenditure is, principally, the high price of coke and coal, which makes the item of fuel amount to over forty per cent. of the total expenses. The coal, of which the Company make their coke, has to be brought from a very great distance, and a ton of coke has cost them, hitherto, not less than £2 14s. The use of wood has been tried, but abandoned again, on account of the sparks.

[TO BE CONTINUED.]

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## Architecture.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Alleged Degeneracy of Modern Architecture.* By ROBERT CARY LONG, *Architect, Baltimore, Maryland.*

I have noticed, with great pleasure, that in the new series of the Journal of the Franklin Institute, a place has been set apart for architecture.

This is as it should be. It is as well the duty, as the interest, of architects, to enlighten public opinion on the subject of their profession; their duty, because the art they practice is in a high degree refining and ennobling in its influences on the public mind; their interest, because architects cannot live unless the value of the art is recognized, understood, and properly appreciated. People understand, well enough, that they should be careful in choosing those who are to represent them in legislative assemblies; but how lamentably do they neglect that art, whose products represent them, not only to the present age, and in the eyes of cotemporaries, but which are to declare to future generations "what manner of men they were."

In the present condition of things, the enlightenment of public opinion will unquestionably depend on architects themselves, as there are none others who seem to know or care much about it.

As an earnest of *my* interest in the subject, I am induced to disburden myself of sundry thoughts which have suggested themselves, from constantly meeting in the foreign reviews and magazines, the oft-repeated allegation of "the degeneracy of modern architecture."

What do the critics mean by "degeneracy of modern architecture?" It is a stereotyped phrase used by both great and small writers, and, by the frequency of it, we cannot but believe that it means something. When we look, however, into the books, or consult the magazine-articles of said critics, we are puzzled to find out, exactly, what this something is.

If we listen to some of them, we must needs conclude that there never was any architecture but the Gothic, and that there never will be any again until the Gothic is *revived*, thus admitting that Gothic



architecture is now dead, in a stupor, or else has fainted away in very weakness.

From another set of essayists, we learn that Palladio first invented that thing called architecture; that, before his time, people built, "every man according to what was right in his own eyes," until Palladio taught them better, and gave such unerring rules for the production of design in architecture, showing so indisputably what is beautiful and what is not, that thence forward the simplest tyro in art need never go astray.

Hear also your modern Greek, swelling with all the grandeur of the age of Pericles, and familiar with the proportions of the Parthenon, he will tell us that other nations have, in divers ways to be sure, built temples; the Egyptians, for instance, had a few, and in the dark ages, among the barbarians of Europe, a strange kind of a structure, called a cathedral, was erected in a most barbarous manner, without columns, entablatures, or pediment; the principal characteristics being great overgrown windows, and sharp spires, or steeples, running up into the air; all this, however, they aver, was not architecture, because architecture consists of three orders, and a building that has not one of these three orders is of no order of architecture, but is mere disorder, and cannot, in the nature of things, be considered as a production of architecture. Indeed, it may be questioned, whether the veritable temple of Solomon, built by the wisest man on the earth, and according to the express directions of the Almighty, or that tabernacle which Moses built, "according to the pattern shown him on the Mount," if discovered by these modern Greeks to be of no one of their three orders, would not be pronounced by them to be entirely out of proportion, and that the builders must have made a mistake, certainly had never read Vitruvius.

Widely, however, as these scholiasts differ, there is one point upon which they all agree, and this is, they all equally deplore the *degeneracy* of modern architecture, and cry loudly for the *revival* of some one favourite style, in order to regenerate the defunct art.

But let us inquire what do the critics mean by "the degeneracy of modern architecture." Is it degenerate because it is not Gothic; because it is not Greek, not Palladian, not Elizabethan, not Egyptian? If so, then in truth we say, architecture will never be any thing else but degenerate, unless we either turn Greeks, or Romans, or Egyptians, &c., and assuredly no one believes that such is ever going to be the case.

Yet why are architects taking it for granted that nothing is architectural unless it be either Greek or Gothic, or some other style, and that, if drawing from these sources they did not try to throw into

their designs a portico, a pediment, or fasten buttresses and pinnacles to the outside walls, or shape the door and window heads into some particular curve, or arch, or indeed apply any other features which can be taken entire out of books, that all trace of architectural art would vanish from the earth? These are *civilized* times, and men require houses to live in; they worship God, and must build temples, if not for His glory, at least for their own comfort, and in ministering to these requirements, this practice of pinning to a building appropriated to either of the above uses, some of the embellishments of another building, held as classic precedent, producing excrescences which architects seem to think are the only things about the structure which have any right to the name of architecture, is, in fact, the great hindrance to the natural growth of architecture. It is *this* practice which is the degeneracy of modern architecture.

Is it to be supposed that Grecian architecture would ever have grown to what it is, if the architects of that land had not given free room for the genius of their country, and its institutions, to manifest itself architecturally? Imagine *them* believing that the Egyptian was the only correct architecture, and insisting on sloping the sides of their buildings, placing their columns within the walls, and hiding their sloping roofs, necessary for the climate, behind an immense horizontal entablature. What a monster would have frowned from the heights of the Acropolis, instead of the ever living edifice that stood there glowing with the life, the youth, the poetry of Greece.

Why was it that the Romans never attained to an original style of architecture, although they had, to begin with, that emblem of strength and beauty, the arch, as an elemental national feature? Simply because they believed that the Greek was the only architecture in the world. They therefore modestly used the arch as a constructive element, and imprisoned it within an external Greek façade, binding the free curve of their own glorious arch under the dominion of column and entablature. This was to put the full blooded Arabian courser into the harness of Juno's peacocks, and then wonder to see the goddess upset, the harness broken, and the chariot shivered.

Thus it was that the arch, with the Romans, never gave birth, as it should have done, to a national style, and yet we see how, in different hands, out of that same arch and its wonderful capabilities, the Norman style was formed, and thence by true artistic treatment, managing this same arch with the buttress, it became the most yielding thing in art-creation, the graceful, the flexible Gothic, coming out of it "as sweetness out of strength," honey indeed "out of the jaws of the lion."

And yet the degeneracy of architecture is now loudly talked of,

and no one sees at the present day *how* any thing new is ever to be done in that art, except by adherence to the rules, not according to which any greatness in architecture was ever achieved, but according to which you may copy any given production of the art.

According to these same critics, it would be easy to show that modern architecture is not by any means degenerate, if their own rules of perfection are at all good for any thing. Is the Parthenon good architecture? What hinders us from building a Parthenon? The money being given, we could re-produce that, or any other building that has been be-measured as the Parthenon has been. Is Yorkminster good architecture? Then the front of the new national Scotch church, in London, is assuredly good architecture enough to content one, for it is as near a fac-similie of the west front of York cathedral as modern means will allow. Indeed, do we not possess already a modern specimen of every conceivable style that has existed in any quarter of the globe? Surely then, according to such views, our architecture is not degenerate. But has this endless repetition of the architecture of the past, any title to be called the architecture of the present? is this the way to produce any thing new, or good, or great, in architecture, any thing bearing on it the impress of the characteristics of this generation, any thing homogeneous with the advanced state of civilization?

Truly, indeed, modern architecture is degenerate, is utterly dead, we should say, in view of what we have just shown, (for if there is any modern architecture at all, what, and where is it?) did we not possess a cheerful faith, which is ever telling us that architecture is too intimately connected with man to perish while there is a man upon the earth. Must *man* progress in goodness and in wisdom? then must *architecture* also! Is man so progressing? then is architecture also, though we may not know it nor see it. Architecture must manifest the changes that are taking place in society, the greater ones, we hope and believe, that are yet to come.

It is as much out of the rule of rationality to think it possible to re-invigorate architecture by forcing it into any antique mould, as to expect that, if disgusted with manhood, we can bring back simplicity and innocence by putting on again the garments of youth. Architecture must grow naturally, its own peculiar tendencies must be observed, and it must be trained accordingly. How is this to be done? let us all try to find out, let us all try and see which of us will first produce something in the art peculiar—characteristic—suited to the age—national.



## Mechanics' Register.

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LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1840.

*With Remarks and Exemplifications by the Editor.*

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1. For constructing *Truss Frames, principally intended for Bridges*; William Howe, Warren, Worcester county, Massachusetts, August 3.

This bridge is, in many respects, similar to that patented by the same person on the 10th of July last, and noticed in our last number, but instead of wedges, screws are used for cambering the bridge, and instead of posts, extending from the lower to the upper string piece, iron bolts, with a screw and nut at the top, are employed. The first set of braces and counter braces, start from the top and bottom of the first bolt, pass by the second, and abut against the top and bottom of the third—the second set commence from the second bolt, pass the third, and abut against the fourth, and so on to the end of the bridge. The screw bolts pass through wedge pieces of wood, at top and bottom, and the ends of the braces and counter-braces, abut against them, instead of against the screw bolts. By this arrangement it will be seen that as the upper and lower strings may be brought nearer together by screwing the nuts on the ends of the screw bolts, and that the action of the braces and counter-braces will thereby camber the truss.

Claim.—“What I claim as constituting my invention in the above described truss frame, and which I desire to secure by letters patent, is the manner in which I have combined the iron bolts, and the wedge pieces, against which the braces and counter-braces abut, so as to co-operate in increasing the camber to any desired extent, the whole truss frame being constructed, and acting substantially, as herein set forth.”

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2. For a machine for *Cleaning Grain*; Amos Adams, Port Henry, Essex county, New York, August 3.

This machine is, in its general construction, old; its novelty consists simply in covering a revolving cylindrical screw, which works on a fixed horizontal axis placed at the top of the conical beater, with wire gauze, the meshes of which are of different sizes. That end of it in which the grain is fed, is covered with wire gauze of such fineness as not to allow the grain to pass through, but to permit the escape of the dust, and the remainder is covered with gauze of larger meshes, so as to permit the escape of the grain, but not of substances which are larger than the grain, these creeping through the open end of the screen. The patentee also combines such a screw with a revolving vertical beater and case, in which the grain is to be beaten and cleaned. The grain is fed in from the revolving screen, between the revolving beaters and the outer case, by means of a hopper.

The claim is to the "manner of constructing the revolving feeding screen, and of combining it with the body of the instrument in which the beating and agitation of the grain are effected, as herein set forth."

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3. For a *Machine for Throwing Balls and other Bodies*; Joseph Martin, Louisville, Kentucky, August 3.

This patent is for improvements on a machine for throwing balls by "centrifugal and projectile forces," patented by Robert M'Carty, of New York, on the 31st of December, 1838, and noticed at page 380 of the 24th volume, second series, of this Journal; the objections there made by us we deem equally applicable to the plan under consideration.

We omit the claims, as they refer, throughout, to the drawings, and could not be understood without them.

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4. For a *Mill for Breaking and Grinding Bark*; Richard Montgomery, and Lewis W. Harris, Sargerfield, Oneida county, New York, August 12.

This mill purports to be an improvement on that kind of bark grinder and breaker, in which a nut and case are used, similar to those of the common coffee-mill; and it consists simply in attaching to these, by means of arms, one, or more, concentric nuts, or grinders, and cases. The second and third, &c. nut, or grinder, have teeth on the inside as well as outside, and the inside teeth of the second grinder act against teeth on the outside of the case of the first, or central, nut, and the outside teeth act against teeth on the inside of the second case. The nuts, or grinders, are united by arms at the bottom, and the cases by arms, or braces, at the top, between which the bark, &c., is fed.

The claim is to the "combination of the conical nuts, two, or more, with the cylinders (cases,) placed concentrically."

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5. For an improved mode of constructing the *Packing for Pistons, &c. of Steam Engines*; Charles F. Pike, Providence, Rhode Island, August 12.

(See specification.)

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6. For a machine for *Beveling Boot Forms*; Elijah Holmes, Stoughton, Norfolk county, Massachusetts, August 12.

The boot form is attached to a frame placed upon a suitable bench, provided with guide grooves, into which pins, projecting from the bottom of the frame, fit, to guide the boot form, so as to receive the proper shape when presented to a double cutter wheel, which revolves horizontally. This cutter wheel is provided with a deep groove, and has one set of cutters attached to the upper, and one to the lower part, facing each other, each set forming one-half of the bevel of any desired form.

Claim.—"Having thus described my machinery, I shall claim re-

ducing, or beveling, the edges of boot forms, in the manner herein above explained, by revolving cutters, in combination with a frame for holding the boot form, the said frame having projecting pins, or guides, traveling in grooves, for the purpose of presenting the form in a proper manner to the action of the cutters, the whole being arranged, and operating substantially, in the manner herein above set forth."

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7. For a machine for *Cutting the Teeth of Circular Saws*; Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The teeth are to be cut by means of a punch worked by a lever, in the usual manner. The saw plate is attached to a circular plate, on the upper end of a vertical spindle, which receives an intermitting rotary motion, so that whilst the punch is cutting off a tooth the spindle is at rest; and when the punch is lifted up clear of the saw plate the spindle is moved around the space of one tooth, its motion being again arrested. This is effected in the following manner. On the spindle there are two toothed wheels, one above the other; the teeth of one are made in the usual manner, and on the other they are slightly inclined with the axis of the spindle. These wheels are acted upon alternately by two horizontal shafts, which receive their motion from the crank shaft, which operates the punch. That which engages with the wheel having inclined cogs, carries a segment of an endless screw; and the other has a grooved piece, and they are so arranged that just as one is disengaged the other commences its action; that with the screw actuates the spindle, and the other keeps it at rest. The size of the teeth to be cut will be regulated by the diameter of the intended saw, and the inclination of the threads of the screw.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts, for giving a regularly intermitted motion to the circular saw plate, and for holding the same still and steady in the intervals of motion, and of the parts for cutting the teeth."

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8. For a machine for *Filing the Teeth of Saws*; Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The patentee says, "My invention consists in causing the saws, which are to be filed, or smoothed, to pass with a regular intermittent motion of the distance of one tooth under a file, to which a movement is given corresponding with the motion of the saw plate, and the form of the tooth to be filed, and the whole so combined and arranged into parts, that during the time in which the file is acting upon the teeth the plate is holden steadily, and without motion, until the file has performed its office, at the same time giving to the file a peculiar compound motion, which may be varied, so as to be accommodated to the perfect filing of any saw tooth." The motion is given to the saw plate in a manner similar to that of the machine for cutting saw teeth, above noticed. The files used are straight, two being used, one on each side, and crossing each other at any desired angle.



Claim.—“What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts for giving a regularly intermitted motion to the same plate, and for holding the same still and steady in the interval of motion, and of the parts for filing the teeth.”

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9. For an improvement in the *Machine for Sawing Stuff Circular*; Thomas Kenderdine, Jr., Harsam township, Montgomery county, Pennsylvania, August 12.

A saw is to be strained in a frame similarly to those employed by cabinet makers for sawing curves. This frame works on an iron guide rod, permanently attached to standards, and passes through holes made in plates that slide in slots made in the end pieces of the saw frame, so that the saw may be set nearer to, or farther from, the rod on which the frame works. The wood to be sawed is fixed in a clamp attached to a frame, provided with the necessary carriages, &c. The claim is confined to the “use of the guide rod passing through the sides of the saw frame, which is to be made adjustable, so as to adapt it to different curves, as described.”

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10. For an improvement in the *Screw Wrench*; Stephen Keane, Thomas Keane, and James Keane, City of New York, August 12.

The movable jaw of this wrench is actuated by means of a screw revolving on a stem attached to the back of said jaw, the threads of which take into worm teeth cut in the edge of the wrench handle.

The claim is confined to the manner of “constructing the movable jaw by combining therewith a revolving screw, whose threads work into worm teeth cut into the edge of the wrench handle.”

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11. For a machine for *Sawing and Splitting Timber*; John P. McDowell, Summit, Cambria county, Pennsylvania, August 12.

In this machine two circular saws are used, one at each end of a frame, which is hung on an axis, so that either saw can be brought down against the wood to be sawed, whilst the other is elevated, and relieved from the piece which has been cut. The saws are driven by a band passing around a whirl on each saw shaft, and receiving motion from the main shaft, which forms the axis of vibration of the frame. Each end of the main frame of the machine is adapted to receive a log, and is provided with the necessary fixtures for holding it during the operation of sawing, and for gauging the length of the piece to be sawed, which, after being cut off, runs down an inclined plane to a place in the middle of the frame, where it is split by being forced against a set of cutters, by means of a follower.

The claim is confined to the “combination and arrangement of machinery for sawing, with the machinery for splitting logs and other materials.”

12. For an *Alarm Lock for Doors*; David Edwards, M<sup>c</sup>Connelsville, Morgan county, Ohio, August 12.

This patent was granted for the combination of an alarm with a door lock, and for a peculiar arrangement of an escapement, which operates the striker of the alarm bell. The bell, and the machinery which operates the hammer, are placed within the frame, or case, of the lock, and are so arranged that, when set, any attempt to push back the bolt actuates the alarm. We omit the claim, as it refers, throughout, to the drawings.

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13. For a *Machine for Boring and Mortising Chairs, &c.*; William L. Harley, Chagrin Falls, Cuyahoga county, Ohio, August 14.

The first item claimed is, "the construction of the bit, with cutters on the end, and teeth in the sides, in combination with the twist." This bit is formed like the single twist auger, with a cutting lip at the end, cutting edges running the whole length, so as to bore out mortises, by giving to the piece of wood to be mortised a reciprocating movement.

The second item claimed, is the "combination of the two carriages, the lower one resting upon a stationary frame, and moved in it lengthwise by a lever, to give depth to the holes and mortises to be bored, and the upper one moved transversely by a crank, to give length to the mortises." This part of the claim needs no explanation. The third item of claim is to the "construction of the frame for the seats to rest on, so as to be presented obliquely to the bit, in combination with the lower carriage. And the last item is to the "construction of the frame for the legs to rest on, to be presented obliquely to the bit, in combination with the lower carriage." The constructions claimed under the two last sections of the claim can be imagined by mechanics more readily than they can be explained without drawings. These frames are provided with joints and slides, so as to present the part in any desired position. The bit is put in the mandrel of a lathe, and the machine presented to it with any part of a chair which is to be bored or mortised.

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14. For an improvement in the *Rotary Fan Blower for Forges and Furnaces*; James Stewart, Springfield, Robertson county, Tennessee, August 17. Antedated July 1st, 1840.

This improvement consists simply in using two, or more, fan wheels on the same shaft, each contained in a separate chamber; the current generated by the first wheel is received into the second chamber, and passes through the second, third, and so on, if more than two are used. Claim.—"Having thus fully described the nature of my blowing machine, and shown the manner in which the same is carried into operation, what I claim therein as constituting my invention, and desire to secure by letters patent, is the placing of two, or more, fan wheels upon the same shaft, but within separate compartments, combined and connected with each other in the manner herein set forth."

We have seen this machine in operation in blowing a smith's forge, and its action was such as to bespeak real utility; we have not, however, heard of its adoption by mechanics, and suppose, therefore, that it has not redeemed its promise.

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15. For a *Smut Machine for Cleaning Grain*; John Burch, Millport, Chemung county, New York, August 17.

This machine has a cylinder, formed of wove wire, or perforated sheet metal, with triangular ribs, running its whole length within the wire. This cylinder revolves slowly on a horizontal, or nearly horizontal, shaft, whilst the shaft revolves with great rapidity, and carries suitable beaters. The slow revolution of the cylinder furnished with ribs carries up the grain which is discharged upon the beaters. Motion is given to the cylinder and beaters by well known means, which need not, therefore, be described. The claim is confined to the "revolving of the revolving cylinder, with its perforated surface and triangular ribs, with the revolving beaters placed on a shaft in the axis of said cylinder, so as to constitute a grain cleaning, or smut machine, constructed and operating substantially in all respects, in the manner herein set forth."

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16. For an improvement in the *Railway Track, for Turning Short Curves*; Henry M. Naglee, City of Philadelphia, August 17.  
(For specification see vol. 27th, p. 171, 2nd series.)

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17. For improvements in the *Dredging Machine*, for deepening Harbours, Rivers, Canals, &c.; William Easby, City of Washington, D. C., August 25.

This machine is intended to be worked by horses, that travel on a circular platform, built on the deck of a large scow. The whole machine is made narrow enough to pass through a canal lock, and in order to make the platform, on which the horses travel, of sufficient size, a segment of the circle, called a wing, is hinged on each side to the scow, so that in passing through a canal lock, or any other narrow place, the wings may be turned up. The scoop is to be worked by two barrels, or drums, placed one at the top, and the other at the bottom, of a vertical shaft, in the middle of the platform—these drums are, alternately, thrown in and out of gear by means of a vertical sliding bolt, and a horizontal lever, worked by the attendant. The chain that draws up the scoop passes around a roller at the end of the machine, and thence around the barrel at the top of the shaft, and that which draws it down and back, passes under the platform, and winds on the lower barrel.

The scoop is attached by one of its sides to two long guide poles, that slide in loops made in two collars, turning loosely on the ends of a horizontal windlass, which forms the axis around which the scoop swings, when drawn up or let down. In letting down the scoop, the chain which is attached to its bottom, is drawn in by throw-



ing the lower barrel into gear; this causes the guide poles of the scoop to slide in the loops, which brings it near to the windlass, and after it has passed a vertical line its gravity causes it to sink. The lower barrel is then thrown out of, and the upper into, gear; by this the scoop is drawn along the bottom, and filled, and then, with its load, is drawn up out of water. The stuff raised is discharged from it into a scow, or other receptacle, by pulling a rope, or chain, which disengages a spring catch, by which the hinged bottom is fastened. The bottom is closed as the scoop strikes the water, in the operation of being drawn down to be re-filled. The distance to which the scoop descends below the windlass, around which it works, is regulated by a chain, which winds around it, and is attached to a brace connecting the two guide poles together, near the scoop.

Claim—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the barrels on the perpendicular shaft, for winding and unwinding the main chains, in combination with the vertical sliding bolt and lever, for throwing the barrels in, and out of, gear, with the shaft, by which the scoop, or bucket, is alternately raised, lowered, and drawn back, whilst the animal, by which the main shaft is turned, continues to travel on the circular tracks without interruption." Also the combination and arrangement of the parallel guide poles, chains, and windlass, for raising the scoop, so as to draw it back to its proper position, as described;" and this I also claim in combination with the scoop and the apparatus for "disengaging the drop, or shutter, to discharge the load, as described." I also claim "the arrangement of the wings of the horse track, which can be raised, and thereby reduce the width of the machine, so that it may pass through a canal lock, or any other narrow place, as described."

18. For *Conducting Grain and Straw after it has been Thrashed*; Luther Whitman, Winthrop, Keunebeck county, Maine, August 25.

The general principle of this machine does not present any thing new, and the claim has, therefore, been confined to the peculiar arrangement of the parts. Slat of wood are attached, edgewise, to two chains, which pass around two rollers. The belt, or chain, of slats thus formed, slides on an inclined board, so that the slats form the sides, and the inclined board the bottom, of a series of cells. One of the rollers around which this belt works, is placed under the thrashing cylinder, and the other roller is placed near the elevated end of the inclined board, at the back part of the machine. As the straw and grain are thrown out by the thrasher, the former falls on the top of the slats, and the latter passes into cells formed by the slats, and by the inclined board, on which they are sustained, and the straw and grain are thus carried up, and the former is discharged on to another belt of slats, called the carrier, which conveys it off to a distance, while the grain falls on a board, which conducts it to the fanning machine.

Claim.—"What I claim as my improvement, and for which I ask

an exclusive right, is the combination of the endless belt of slats, constructed as herein described, with the inclined board and straw carrier, the whole being so arranged that the belt, while it conveys the straw from the thrasher, carries the grain also with it up the inclined plane, in the manner described."

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19. For improvements in the *Machine for Planting Corn and other Seeds*; Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This machine is a modification of that kind of seed planter in which the seeds are taken from the hopper and carried around to a dropping tube, by a wheel, with cavities made in its periphery; the improvement consists simply in making the cavities in separate pieces, which fit into receptacles made for that purpose, in the wheel, so that pieces with different sized cavities may be employed at pleasure for different kinds of seed.

The claim is, first to "constructing the dropping cylinder with changeable slides, and forming receptacles in the same for receiving the seed from the hopper; also the mode of adapting the lower part of the hopper to the apertures in the end of the slides, by forming it with chutes, in the manner set forth, so as to better conduct the seed to the receptacles in the slides, the whole being arranged, and operating substantially, as above described." Second, I claim the mode of compressing, or regulating, the "stiffness of the brush (which makes a part of the hopper,) by means of the clamp and screw, in combination with the hopper and dropping cylinder."

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20. For a *Cooking Stove*; Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This stove is circular—the fire-chamber, which is conical, and provided with a grate at the bottom, is placed in the centre, thus leaving a baking-chamber all around. The fuel is fed in at the top, through an opening in an elevated cap, which opening may be closed by a boiler, or by a cover. The pipe which leads to the chimney passes out from the cap.

The fire-chamber is surrounded by a cylindrical tube, which extends from the lower part nearly to the top of the baking-chamber—at the top it is in contact with the fire-chamber, and as one of these is conical, and the other cylindrical, there will be a space between the two, reaching from the part where they touch, to the bottom; the object of this arrangement is fully explained in the claim. The cylindrical tube is surrounded by a circular perforated shelf, supported on screw rods, which pass through the bottom plate, to regulate the height of the shelf.

Claim.—"I claim the particular mode of adapting the circular shelf to the oven, and adjusting the same by means of screws passing through the bottom plate, also the furnace constructed with an exterior casing, or cylinder, for the purpose of causing the heat radiating from the outer surface of the furnace to pass downwards, and escape

near the bottom of the oven, thereby causing it to be first distributed under the rising shelf, at whatever height the same may be in the oven, the whole being arranged and operating substantially, in the manner, and for the purpose above described." I claim the combination of "the circular shelf with the oven and furnace, the furnace being so arranged in the oven that the shelf shall entirely surround it."

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21. For a *Machine for Planting and Sowing Seeds*; Joseph Gibbons, Adrian, Lenawee county, Michigan, August 25.

The hopper of this machine is made of any desired length to correspond with the number of rows intended to be planted at the same time, and is divided into sections by partitions running across it, each division having a corresponding dropping tube. Below the hopper the machine is crossed by a roller provided with cavities, to receive and carry around the seeds, or plaster; the capacity of these is regulated by a tube of tin, or other metal, that surrounds the roller, and may be made to revolve thereon to a small distance; this tube is provided with apertures, which correspond with the cavities in the roller, and one edge of the metal forming each aperture is turned down into the corresponding cavity in the roller, and reaches to the bottom of it, so that by turning one on the other the capacity of the cavities may be enlarged, or diminished; a roller runs across the machine at the rear part of it, by which roller the rows are to be covered; and when it is desired to stop the seed roller the operator bears upon the handle at the back, which lifts the wheels that operate it from the ground.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I regulate the capacity of the cavities made for receiving and carrying the seed to be planted, or sown, by surrounding the roller in which said cavities are made, by a tubular casing, adapted thereto in the manner described." "I also claim the manner of constructing and using said machine, so that by bearing upon the handle, or handles, at the back part thereof, the roller will operate as a fulcrum, and the distribution of the seed will be arrested."

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22. For a *Card Printing Press*; Samuel Orcutt, Boston, Massachusetts, August 25.

The following is the claim upon which this patent was granted, viz. "What I claim as constituting my improvements, and desire to secure by letters patent, is first, the manner in which I have connected and combined the lever and toggle with the frisket, the inking drum and inking rollers, so that by the depression and elevation of said levers, the frisket shall be carried under the platten, the inking apparatus being brought into operation, and the frisket moved out after the impression has been made, all as herein set forth." Secondly, I claim the general arrangement "of the respective parts of the frisket for holding the card, in combination with apparatus for dropping the card, by withdrawing the parts upon which it is supported, by means



of the angular catches, or triggers, and their appendages. The other parts described I do not claim; as many, if not all of them, have been previously used in other forms."

We could not, within the limits allotted to a single notice, make the character of these improvements more clear than is done in the above claim, without giving drawings, by which the patent is accompanied.

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23. For *Puddling Furnaces for Manufacturing Iron*; Thomas Cooper, City of New York, August 25.

The patentee says—"The nature of my invention consists in providing a reverberatory furnace with a hearth, space, or dead work, around the grate, or fire-bars, by which the brick work of the fire-chamber is protected from intense heat, and from which the clinker is easily removed. With a vertically descending flue when applied to puddling, scrapping, bitteting, or heating iron with anthracite coal; and in the combination of two, or more, heating bottoms and fire-chambers in one furnace." The grate is made in the middle of the chamber of combustion, or the receptacle for the coal, with dead brick work all around, on which the coal, not fully ignited, rests, and the flue on the side of the heating, or puddling chamber, opposite the chamber of combustion, descends, and then passes out, horizontally, to the chimney. The descending flue, when two heating chambers are employed, is used for the draft of the two chambers of combustion.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the floor, or bottom of the fire-chamber, with a grate in the centre, as set forth, surrounded by a dead work for protecting the brick work of the chamber, as described." "Also constructing the furnace with a vertical descending flue, in the manner, and for the purpose set forth." "Lastly, I claim combining two, or more, furnaces, constructed with grates and dead work, and having a descending flue, all as described."

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24. For an improvement in the *Franklin Cooking Stove*; Reuben B. Houghton, Clarkson, Monroe county, New York, August 25.

The back plate of the fire-place in this stove, instead of running up, as usual, rises only a few inches, and just above the upper edge of it a square shaft extends from side to side of the stove, and passing through one of the side plates is provided with a winch by which to turn it round—from one of the sides of this shaft grate bars project, and from a contiguous side, a flat plate extends at right angles to the grate bars. Between the back plate of the fire-place and the front plate of the oven, there is another plate, extending nearly as high as the top of the oven, with a flue between it and the oven; and the side plate of the stove is provided with an opening, and door to correspond to the space between it and the back plate. By this arrangement the fire may be situated nearer to, or further from, the oven. When the shaft is so turned as that the grate bars lie horizontally, the fire is sustained on the grate, and the dead plate stands at right angles

thereto, and forms the back of the fire-place; and when it is turned, so as to have the grate bars vertical, the plate lies horizontally, and it, together with the grate and the second back plate, constitute a box stove, which is supplied with fuel through the door at the side. Two valves are used to regulate and give proper direction to the draft. The claim is limited to the combination of the "turning grate" with the vertical plate and dampers.

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25. For an *Electro-Magnetic Machine* to obtain a Moving Force for driving Machinery; Truman Cook, New York City, August 25.

The following extract from the specification will give a pretty accurate idea of the invention. "Having thus fully described the manner in which I construct my electro-magnet apparatus, and likewise the manner of making the improved galvanic trough for actuating the same, what I claim therein as constituting my invention, and desire to secure by letters patent, is first, the arranging of the armatures upon a cylinder, or drum, in combination with the pairs of electro-magnets so situated as that the negative and positive pole of each individual magnet shall, at the same moment, be over two contiguous armatures, in the manner herein set forth." "Secondly, I claim the mode of interrupting the galvanic circuit by means of the cams, or notches, on the axis of the cylinder operating the wires which dip into the cups of mercury, as set forth, in combination with the stationary magnets and revolving armatures, arranged and constructed as herein described." "Lastly, I claim the galvanic battery herein described, composed of separate and distinct plates, communicating with cups of mercury, in the manner described, in combination with the electro-magnetic apparatus, consisting of stationary magnets and revolving armatures, as described."

At the period when this patent was obtained, a machine of considerable size had been built, for the purpose of driving the propelling apparatus of a boat; not having heard of the result of the experiment, we are compelled to infer that there is one more to be added to the list of unsuccessful attempts in the employment of the electro-magnetic power as a substitute for steam.

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26. For improvements in the *Machine for Carding, or Picking, Curled Hair*; Francis Harding, Cleveland, Cayuhoga county, Ohio, August 25.

Upon a cylinder about two feet in diameter, and similar to the cylinder of a carding machine, slats are attached, which are about two inches in width, and four inches apart—these slats are covered with cards having two or three rows of strong wire teeth set in stout leather, and bent, or hooked, forward. Over the cylinder, attached to arch pieces, are six stationary slats, provided with teeth similar to those on the cylinder, but with the hooks turned the reversed way. These slats are connected with the arch pieces by means of springs, so as to give them some play; the teeth on these slats are of the same kind as those on the cylinder, but they are less and less coarse as they recede

from the feed apron and approach a brush cylinder, which is opposite a feed apron, by which the machine is supplied.

The claim is to the combination of the stationary and revolving cards, arranged, constructed, and operating as described, and in combination therewith the revolving cylinder of brushes, each brush consisting of a single row of bristles.

The difference between this machine and the carding, or heckling, machines, previously in use, will be manifest from the fact that neither of these machines would perform the operation of picking curled hair; whatever similarity there may be between them, it must be plain that they are by no means identical.

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27. For an improvement in *Chairs*; Matthew W. Ring, New York City, August 25.

The seat of this chair is jointed to a bottom plate so as to rock on it, and the rocking is relieved by spiral springs placed between the seat and plate, towards the front and back edges thereof. The covering around the edges, which unite the rocking to the permanent part of the bottom, is put on so as to give full play to the seat. The bottom plate is connected to the pedestal by a pivot, similar to that used in the stools of piano fortes; and the back and arms are formed of metallic rods, bent in the proper shape, to render them easy and flexible.

*Claim.*—"I do not claim to have invented the before described separate parts of the revolving accommodating seat, but what I do claim as my invention, and wish to secure by letters patent, is the combination of the revolving with the jointed spring seat, as before described." "I also claim the mode of making the spring back and arms, by means of metallic spring bars, or rods, as described."

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28. For a *Cotton Press*; Fowler M. Ray, Catskill, Greene county, New York, August 25.

In this press the follower is forced upwards, and this is effected by the aid of two ropes, or chains, one attached to each end of the follower, and passing thence over a pulley, and having its outer end attached to an arm projecting from a shaft, at right angles thereto. A snail, or fusee, wheel is attached to one end of the shaft, and from this a rope passes to a capstan. When the follower of the press is down, the arms to which the ropes are attached, are horizontal, and the rope from the capstan acts upon the smallest part of the snail wheel, hence the motion of the follower will be rapid, the resistance to its upward motion being at that time small; but as the resistance increases the power of the levers, formed by the arms, gradually increase until the rope winds upon the shaft from which they proceed, and at the same time the snail wheel is also lengthening its purchase, so that at the time the follower meets with its greatest resistance the power applied has also reached its highest point.

This arrangement constitutes a very simple and efficient mode of applying a progressively increasing power to a press.



Claim.—“What I claim as constituting my invention, and desire to secure by letters patent, is the using of the arms, projecting at right angles from the shaft, and having ropes, or chains, attached to them, which pass over pulleys, and raise the follower of the press; the respective parts being combined, connected, and operating substantially as herein set forth.” “I do not claim the manner of constructing and applying the capstan and windlass to my press, although I believe that there is novelty in their mode of construction and operation; nor do I claim any of the other parts described, when taken alone, but I limit my claim, as above, to what I consider to be the distinguishing feature of my press; and this part, or arrangement of parts, I claim, whether constructed precisely in the form and manner described, or in any other which is substantially the same.”

29. For a *Mill for Grinding Apples, or other Fruit*; Thomas J. Wells, New York City, August 25.

The crushing, or grinding, is effected by two disks, whose surfaces are very flat cones, each of them attached to the end of a shaft, and the axes of the shafts are placed at an angle to each other, equal to the angle formed by the cone with its base, so that when the two disks are brought together, one side of the cone of one disk will touch, or nearly touch, one side of the opposite disk, whilst the other portions of their surfaces will be separated. The shaft of one of the disks slides in its bearings, and is pressed up to the other by a weighted lever. A hopper is so placed as to feed the apples, &c., between that part of the disks which are separated.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is the mode above described, of crushing apples, or other fruit, by the action and combination of the two conical disks combined with the lever and pulley.”

30. For an improved *Elevated Oven for Cooking Stoves*; J. P. Williston, and Willard A. Arnold, Northampton, Hampshire county, Massachusetts, August 25.

The following extracts from the specification will be found to give a very clear idea of the improvement. “In elevated ovens heretofore constructed, the body of the oven has been formed of two cylinders of unequal diameter, one of which is placed within the other, at an equal distance, both at the bottom and sides, from the outside cylinder, thus constituting a flue, into which the heated air and smoke are allowed to enter at the bottom, through two, or more, pipes, and to escape from the top through a pipe leading into the chimney.”

“It has been found, by experience, that with an oven so constructed, a much larger fire is required to bake in the oven, than is necessary for doing the ordinary work of the stove to which it is attached.”

“This objection to elevated ovens we have obviated, by enlarging at the bottom the space between the interior and exterior cases, of which the oven is formed, and narrowing it upon its sides and top.”

“What we claim, is the enlarging of the capacity of the flue which

surrounds the oven, at its lower side, and diminishing it on its sides and top, in the manner, and for the purpose described."

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31. For a *Process for Tanning Leather*; Abel H. Buzzell, Bridgeton, Cumberland county, Maine, August 25.

The patentee says—"The nature of my invention consists in raising the hide by the aid of sulphuric acid, (oil of vitriol of the shops,) and when raised sufficiently, so changing the same with tannin that it will not return to its original condition. Then suspending wood ashes, contained in sacks, in the pits, to destroy the compound which is formed by the tannin and sulphuric acid, and which prevents the gelatin of the hide from uniting with the tannin. This method renders the use of the acid, to any desirable or necessary extent, perfectly safe; shortening the period for tanning, and increasing (by means of the acid,) the capacity of the hide for receiving tannin, and adding much to the quality of the leather."

"What I claim in the above process as my invention, and desire to secure by letters patent, is the mode of tanning hides, by placing them, when raised, in a decoction, or solution, of bark, or other liquor containing tannin, and after they have remained there a suitable time, as herein specified, adding an alkali to the liquor, as herein set forth."

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32. For an improvement in the *Lamp for Burning Camphine*; Michael B. Dyott, City of Philadelphia, August 25.

This improvement is described as applied to that kind of lamp formed by the union of two cones, with three inclined burners projecting therefrom. The improvement consists of a plate which rests upon three, or more, screws, by which its height is regulated; this plate is perforated with three holes, through which the upper part of the wicks and flame pass, and as they are larger than the burner, they admit the necessary and desired supply of air, which supply may be regulated at pleasure, by turning the screws on which the plate rests.

*Claim.*—"What I claim as my invention, and desire to secure by letters patent, is not any exact proportion, or number of burners, or the particular mode of disposing, or placing, them in any peculiar form, or situation; but I claim the mode described, of regulating the draught by means of a movable plate, which sustains the glass chimney, and otherwise being constructed and operating as set forth, and described in the above specification."

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33. For an apparatus for *Obtaining Casts from the Teeth and Gums, and for Adjusting the Casts when taken*; Daniel T. Evans, City of Philadelphia, August 28.

The patentee says—"This apparatus consists in an improved mouth mould, which is to be filled with wax, that a perfect impression of the teeth and gums may be taken by allowing the jaws to close upon it; after which, the impression so made, is to be filled with plaster of paris, and this, whilst in a soft state, is to be placed between plates of

metal, in an instrument made to open and close in the manner of the mouth; a portion of the plaster being placed upon said metallic plates, for the purpose of attaching the two portions of the cast thereto."

"I claim as my invention—First, the manner of constructing the mouth mould without a dividing plate, so as to admit of the meeting of the teeth, and of their lapping over each other in taking the impression, as set forth." "Secondly, I claim the manner of constructing and combining the apparatus of plates for receiving and holding the casts, in plaster from the teeth and gums; said apparatus being furnished with a movable plate, the action of which is similar to that of the lower jaw in the living subject."

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34. For an improved *Process for Manufacturing White Lead*; Smith Gardiner, New York, August 28.

(See specification, p. 123, vol. 26, 2nd series.)

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35. For a machine for *Hulling Rice*; Warren Groat, Troy, Rensselaer county, New York, August 28.

The patentee says—"The nature of my improvement consists principally in the construction and application of machinery by which the grain is made to pass between the surface of one body in motion and another at rest, or both in motion at different velocities, or in contrary directions. The one being hard and rough, and the other, yielding and elastic, so that under the regulated pressure for which provision is made, as will be shown in the description, their co-operation will give to the grain the action required, and at the same time allow it to pass without being unnecessarily broken by the process."

"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing a cylindrical surface of files, or of stone, and a yielding and elastic surface, or bed, made by the union of caoutchouc and leather, and employing the said cylinder and bed in connexion, or co-operation with each other, in the manner, and for the purpose above described. And also the placing of files at discretion, between different sections of such elastic bed, and using the same in like connexion with the cylinder, for like purposes, as also above described."

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36. For a *Steam Boiler and Generator*; Dudley Marvin and Oran W. Seely, the former of the city of New York, and the latter of Sodus, Wayne county, New York, August 28.

This patent is obtained for a boiler for generating steam for the purpose of steaming and cooking articles of various kinds. The sides and back end which surround the fire chamber are double, and contain water, and the part of the boiler which is over the fire chamber, consists of water cells, which run from front to back, leaving spaces between for the circulation of the draught of heated air. Division pieces running horizontally from the front nearly to the back, divide the spaces between the cells into two compartments or flues. The



heat impinges on the bottom and sides of the cells, and circulates around the ends of the division pieces, along over them, and out at the chimney flue, which is in front, above the feeding door. The steam is carried off by pipes from the steam chamber to any place desired. The whole boiler is composed of seven parts, so formed as that they may each be moulded and cast in one piece, without the use of cores.

*Claim.*—"We claim first, the manner in which we have constructed and combined the respective parts of our boiler, or steam generator, with each other, as described; that is to say, we claim the formation of the water cells, consisting of one which surrounds the three sides of what we have denominated the principal casting, extending down to the lower edge of said casting, and having three, or any preferred number of water cells, intermediate between the cells at the sides of the principal casting, said intermediate cells extending down so far as to leave the requisite space for the fire chamber, and having spaces between them, which are to be converted into reverberating flues, by means of partition or division pieces, located and operating in the manner herein set forth. We claim, secondly, the forming or making of that part which we have denominated the principal casting, in one single piece of cast iron, by giving to the respective parts thereof, the designated taper, and otherwise constructing the pattern, in the way described, so that it will draw from the mould, and may be cast in a single pair of flasks, without the employment of cores."

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37. For a *Machine for tarring Shivers or Bands of Hemp, and making Oakum of the same*; William Montgomery, Boston, Massachusetts, August 28.

The patentee says—"The object of my invention is to prepare oakum from the Cordilla hemp or tow (sometimes so called) which is of much poorer quality than the Russian hemp; and inasmuch as the fibres of the former are shorter than those of the latter, though equally sound and new, and sufficiently good, for the above mentioned purpose, as it produces a better quality of oakum than that obtained in the manner now practiced from the tarred rope and yarns. Another object of my invention, is to prepare the oakum in a proper roving, or shiver, so that without any further preparation, than that of being properly dried after passing through the operation of my machinery, it can be applied to its purpose of caulking the seams of vessels, &c."

The shiver of hemp is passed between two rollers, and around a reel which revolves in tar, and is provided with radial arms and guides, by which the shivers on the reel are pushed towards one side to make room for the shiver, which is constantly rolling on. After the shivers are taken from the reel, they are passed between two sets of rollers, the first of which press out the surplus tar, and the others being draw-rollers, separate and draw out the fibres, and supersede the necessity of picking. There are weighted, curved guides and rods, which prevent the tar from gathering in lumps, as the shivers

pass through the pressing rollers. We omit the claim, as it refers throughout to the drawings.

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38. For *Heating the Blast of Smelting Furnaces*; William H. Phillips, Brooklyn, New York, August 28.

(See specification.)

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39. For a *Composition for rendering Leather Water-proof*; Charles F. Miller, city of Baltimore, Maryland, August 28.

The ingredients which form this compound, consist of one part of beeswax, one part of spermaceti, one part of rosin, half a part of suet, half a part of hog's lard, and a quarter of a part of borax. The borax is pulverized, and put into a vessel with the other ingredients, and melted over a slow fire. The mixture is to be put on the flesh side of the leather, at a tepid heat, and the application repeated, until it appears on the grain side—it is then suspended in an oven. After it is taken from the oven, it is rendered smooth in the usual way, by rubbing and bending. It is then rubbed on the flesh side with armenian bole, or red chalk.

*Claim.*—"What I claim is the particular compound, composed of the materials, and combined in the proportions, or nearly in the proportions, above set forth. And I also claim the manner of applying this compound, and preparing the leather for use, by exposing said leather in an oven, properly heated, in the manner, and for the purpose, herein made known, in combination with the subsequent process of filling the pores on the flesh side, with armenian bole, or other absorbent earthy matter possessed of analogous properties.

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39. For a *Molasses Gate*; Ammi West, Greene, Kennebec county, Maine, August 28.

The forward part of the tube, or body of the faucet, is made conical, the larger part being towards the cask; a conical cap fits and revolves on it. The two are kept tight by means of a screw, which passes through the end of the cap, and screws into the tube or body. A hole is made in each, through which the molasses is discharged, when they coincide, but when the cap is turned on the body, or tube, its flow is cut off.

*Claim.*—"What I claim as my invention, is the mode herein described, of tightening the cap upon the inner tube, by making them of a tapering or conical form, and connecting them by a screw, in the manner set forth, so that when the cap is screwed down upon the inner tube, it shall, owing to the conical form I have given the cap and tube, be made to embrace the latter more closely, and thus prevent leakage as the parts wear away."

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40. For an *Improvement in Saw-Mill Dogs*; Martin Rich, Ithaca, Tioga county, New York, August 28.

These improvements consist in a peculiar mode of constructing the

dogs—in operating the slides by means of two endless screws on the same shaft—in a combination and arrangement of parts, by which the log is set by the motion of the carriage—and in the peculiar manner of constructing the rack which sets the log.

The dogs are made of a quadrangular frame of iron, with teeth on one side; this frame slides in a mortise made for that purpose, in an iron standard, which slides in the head block. The dogs are retained in place, after being driven into the log by a screw or wedge at the top.

A shaft runs across the head-block, with two endless screws, one on each side of the kerf, which take into a rack on each of the slides which carry the dogs. The outer end of the shaft has a cog wheel, the cogs of which take into cogs on a rack, attached to a vibrating bar, for throwing the rack in and out of gear, by which the log is set. The cogs on this rack are movable, and the number of them will regulate the thickness of the set which will be given to the log.

*Claim.*—"What I claim as my invention is, first, the manner in which I have constructed and arranged the improved dog, as set forth, namely, the giving to it the form of a triangular frame, furnished with teeth on one side, and sliding through an opening, or mortise, in a standard affixed to, or making a part of, a sliding plate and rack, by which the log is carried in setting; said dog being held in the required position by a screw, or wedge. I claim, secondly, the arrangement and combination of the parts concerned in the setting of the log, by the return motion of the carriage: said combination consisting of the shaft, with its right and left handed screws; the cog wheel on its end, and the vibrating bar for throwing the rack into and out of gear. I claim, thirdly, in combination with the log setting apparatus, the manner of constructing the rack with movable teeth, for the purpose described."

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#### SPECIFICATIONS OF AMERICAN PATENTS.

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*Specification of a Patent for an Improved Mode of Constructing the Packing for Pistons, &c. of Steam Engines. Granted to CHARLES F. PIKE, of Providence, Rhode Island, August 12th, 1840.*

To all to whom these presents shall come: Be it known that I, Charles F. Pike, of the City of Providence, in the county of Providence, and State of Rhode Island, have invented a new and improved mode of constructing the packing of pistons, piston rods, and valve stems, and I do hereby declare that the following is a full and exact description of the same.

The nature of my invention consists in the use of cylindrical metallic wedges, within side of metallic rings when used for the packing of pistons; and without side of metallic rings when used for the packing of piston rods, or valve stems.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation. I construct



my packing for steam engines, or other pistons, by making two rings of cast iron, or other metal, turned as large as the diameter of the cylinder, and so wide that the rings will just fill the space between the head and follower of the piston when ground together. I saw said rings open, so that they may expand to fill the cylinder. I make a cylindrical wedge as wide as the two rings afore-mentioned, the external diameter of which will just admit it to slide within the afore-mentioned two rings when they are placed in the cylinder. The internal diameter of said wedges being conical, and as much larger at one end than at the other, as may be deemed necessary, said wedges being cut longitudinally into four, or more, parts, so that each part may be forced out from the centre against the two rings afore-mentioned. I make another cylindrical wedge in the form of the frustum of a cone, and about seven-tenths as long as the one last named, the external diameter and taper of which corresponds with, and fits into the internal diameter of the large end of the other, the thickness of which I make sufficient to admit of screws being tapped into it, to move it longitudinally on the barrel of the piston. To keep said wedge in its place, I put in four, or more, screws, with collars on them, to be let into the followers, two on one side, and two on the other. Two with the collars on the inside shove the wedge ahead, and the other two hold it, or draw it, back. I construct my packing for piston rods, &c., by making two rings of brass, or other metal, of a diameter that will just admit them on the rod, and so wide as just to fill the space between the bottom, or the bushing, and the cap, when ground together, and of a thickness of about one-eighth of the diameter of the piston rod, which I cut open, and place on the rod, so as to break joints. I make a cylindrical wedge of a width and internal diameter, corresponding with the width and external diameter of the two rings afore-mentioned. I make said wedge thicker at one end than at the other, to give it the proper taper, and cut it longitudinally, into four, or more, parts, so that each part may be forced in towards the centre against the two rings afore-mentioned. I make another cylindrical wedge about seven-tenths as wide as the last named, the internal diameter and taper of which corresponds with, and fits on the external diameter of the small end of the other. The thick end I make of a proper thickness to admit of four set screws, made in the same manner as described for the piston, the external diameter of which is the same as the internal diameter of the head, or stuffing box; I fit on a cap with set screws therein, to adjust the last named wedge, so as to keep the two rings snug to the rod.

Having thus fully described the manner in which I construct and arrange the respective parts of my metallic packing, what I claim therein, and desire to secure by letters patent, is the within described manner of packing the piston of a steam engine by the combined action of the conical wedge operating upon the sectional wedges, and these upon the divided rings, the conical wedge being adjusted by set screws, the whole being constructed and operating substantially as set forth.

I also claim the employment of divided rings to constitute the pack-

ing of a piston, these having been before used, but under an arrangement of the necessary parts, essentially different from that employed by me.

I also claim the packing of piston rods, and of valve stems, by an arrangement of the respective parts constituting the packing, similar to that employed in the packing of pistons, but situated in a reversed order, the divided rings embracing the piston rods, or valve stems, as above made known.

CHARLES F. PIKE.

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*Specification of a Patent for an Improved Apparatus for Heating the Blast of Smelting Furnaces. Granted to WILLIAM H. PHILLIPS, of Brooklyn, New York, on the 28th of August, 1840.*

To all whom it may concern: Be it known that I, William H. Phillips, of the City of Brooklyn, in the State of New York, have invented a new and useful improvement in the manner of heating the air to supply the blast in those smelting furnaces in which mineral coal is used, and in which there is an air-heating apparatus at the tunnel head; and I do hereby declare that the following is a full and exact description thereof.

For the purpose of economizing fuel, it is a point of considerable importance to be able to use the waste heat for supplying the blast to the smelting furnace, and this has been done in numerous instances, and under various modifications of the apparatus employed. It has been found, however, that in all cases, the air so heated, is subjected to great variation in its temperature, and that from causes incident to the employment of such furnaces when dependence is had upon the waste heat alone to accomplish the intended purpose. Whatever produces a diminution of heat in the interior of the furnace must produce a corresponding effect in the air-heating apparatus, and that at a time when it is most desirable to keep up, or increase, the temperature of the hot blast, in order the more rapidly to restore the wanted temperature in the furnace. One of the most general causes of the temporary diminution of heat in the furnace is the introduction of the charges of coal, ore, and flux. The quantity of gas emitted from the fuel also varies considerably in different stages of its combustion, and with it, of course, the quantity of flame in the heating apparatus; other sources of such variation of heat are well known to those conversant with the use of smelting furnaces. My improvement is intended to, and does, effectually, obviate this difficulty, and that in the following manner.

On the sides of, or otherwise close to, the heating apparatus on the tunnel head, I place one, two, or more, small furnaces, for the express purpose of heating a portion of air which is to pass from them into the heating oven, and to co-mingle with that arising through the chimney of the smelting furnace. To these auxiliary furnaces I make close fitting doors, in order that no air shall pass into them, excepting that which is forced to pass through the burning fuel which they are to contain.

Into the ash-pit of these auxiliary furnaces I introduce a pipe, through which air, either hot, or cold, may be blown from any suitable part of the blowing apparatus, which, by passing through the ignited fuel, and thence directly into the heating oven, may be made to communicate a very high degree of heat to the pipes contained therein; I of course regulate the supply of air to be blown into the heating oven, and to pass from the blowing apparatus into the auxiliary furnaces, by means of cocks, valves, or dampers, applied in the ordinary way, which devices are well known to all machinists.

Having thus made known the nature of my invention, and shown the manner in which the same may be carried into operation, what I claim therein as constituting my improvement, and desire to secure by letters patent, is the combining with the ordinary air-heating apparatus, on the tunnel head of a blast furnace for smelting iron, by means of mineral coal, one, two, or more, small auxiliary furnaces, into the ash-pits of which air is to be blown, and to be heated by passing through ignited coal, and thence conducted immediately into the heating oven; the whole being connected and combined substantially in the manner, and for the purpose, above set forth.

I will here remark, that when it is not requisite to employ the heat from the auxiliary furnace, or furnaces, by closing the valves in the passages leading into, and from them, the contained fuel will merely remain ignited, scarcely undergoing any combustion, until urged by the blast.

WILLIAM H. PHILLIPS.

## **Progress of Physical Science.**

*Notes and Diagrams, illustrative of the Directions of the Forces acting at and near the surface of the Earth, in different parts of the Brunswick Tornado, of June 19th, 1835. By A. D. BACHE, Professor of Natural Philosophy and Chemistry, in the University of Pennsylvania; one of the Secretaries of the American Philosophical Society. Read April 2d, 1836.\**

IN company with my friend, Mr. Espy, I visited, in the early part of July last, the scene of the destructive tornado of June 19th, the ravages of which had been most severely felt in New Brunswick, New Jersey, and its vicinity; the effects extending about seven and a half miles to the west, and ten to the east of that place. The idea of illustrating these effects by the aid of instrumental means, first occurred to me after hearing an interesting account by Professor Johnson, before the Academy of Natural Sciences of this city, of an examination made by Professor Henry and himself, of the position of materials carried by the storm from the city of Brunswick, and deposited in a field on the opposite bank of the river Raritan.

\* The views of Mr. Redfield in reference to this tornado, having been recently published in this Journal, it is deemed proper to re-publish the article of Prof. Bache. — *COM. PUB.*



The regularity in the general arrangement of these materials, gave me the hope that further facts of interest might be brought to light by an examination of the country along the path, and fully established, as well as clearly represented to the eye, by diagrams laid down from actual measurement.

To this point I devoted exclusive attention during the limited time which a very brief recess from duty at the University afforded me. Mr. Espy collected at the same time the accounts of those who had witnessed the phenomenon, examined closely the general circumstances, and is equally concerned with myself in any claim to novelty in the results about to be submitted. As he will embody the deductions from the information collected, and from the general observations which we made, I do not propose to go into them further than is necessary to make my results intelligible.

The accompanying diagrams, plates III, IV, represent different portions of the track of the storm, from the point at which its effects were first felt in any considerable degree, to a point about a mile east from Brunswick, where I was reluctantly obliged to close my observations.

They were obtained by means which, though rough, are abundantly exact for such a purpose, namely, by measuring the angles to be taken, by the compass, and by pacing the short distances to be estimated.

Such an examination being made of the track of the tornado through a wood, or in any other suitable case, the directions of the acting forces are determined, and thus is ascertained whether they correspond to the effect of a whirl, at and near the surface of the ground, as is generally assumed, or to that of a rushing wind, or, as most fully appears, to that of a mighty column of rarefied air in motion.

Although the action of the storm on buildings, affords many interesting facts in regard to the phenomenon, and in one case, an effect of great interest was thus first pointed out; yet, as we expected, the most satisfactory evidences of the directions of the forces occur, generally, in open woods, and in the plantations near buildings.

It may seem superfluous to a reader accustomed to observation to say, that entire regularity is not to be looked for in the effects to be brought before him. I have, however, thought it best to remark briefly upon some of the causes which might be expected to produce considerable irregularities, in the positions of trees overthrown, or broken, by the storm.

The soil of the part of New Jersey through which this storm passed is a red clay, (from the red shale,) and deficient in strength. The trees growing upon it extend their roots very far horizontally, while they penetrate but a short distance below the surface. They are, therefore, readily uprooted, and in the overthrow, carry a considerable extent of soil with them.

If the forces acting during the whole period that the trees were within the sphere of action of the storm, be supposed of equal intensity but varying direction, then the trees extending their roots un-

equally in different directions, will oppose unequal resistances in those directions, and two trees side by side may be thrown different ways. Several trees presenting thus a want of conformity of direction, would induce, at first view, the idea of a total want of regularity calculated to baffle observation. If the forces vary in intensity as well as in direction, this difficulty will be increased. Again, the circumstances of the proximity of other trees, may not only influence the direction in which a tree will fall, after its motion has commenced, but the very direction in which the force producing its fall may act. And these remarks apply in even greater force to the case in which trees are broken, instead of being overthrown.

The unequal strength of parts of a building, and its protection by adjacent buildings, must produce difficulties of a similar kind; while in the trees near to houses we should look for even more irregularities of direction, than in those in an open wood.

These remarks, it will be seen, are not intended to set aside any cases which may appear inapplicable to a general conclusion, but merely to guard against unreasonable requirements.

Of the diagrams, figures 1, 4, 5, and 7, are drawn to the same scale; the scale of figures 3 and 6 are attached to them respectively; and figure 2 is not drawn to a scale.

The directions of the trunks of trees are represented in all but figure 1 by arrows. In order to make these directions appear distinctly, these arrows are out of proportion to the horizontal distances between the trees. This causes the tops of trees to appear very near, which, in many cases, were not so.

The first point to which we traced the action of the storm, was near the farm of Mr. M. S. Garretson, about seven miles, a little south of west, from New Brunswick. It crossed the Millstone river, and the Trenton and Brunswick canal, about half a mile to the west of Mr. Garretson's dwelling, and its track was between this house and a barn about sixty yards from it. A small portion of a light fence, and some other matters, were carried across the road upon which the house fronts, and a part of the trees in an orchard thrown down. Neither the barn nor dwelling house was injured, and the action was described as that of a strong wind of limited breadth. In the orchard, the trees to the south of the path of the storm, were thrown northwardly, and those to the north, southwardly. Passing on to the east, the next effect was seen in overthrowing a large cherry tree, and carrying off the southwest corner of the thatched roof of a small saw-mill. The most violent action, however, at this place, was upon a wood nearly east from the dwelling house, and is shown in the sketch figure 1, plate III. This is, perhaps, the most hasty of all the determinations which I made, as the interest which attached to the effects wanted the force of novelty: they being similar to those referred to, as observed by Professors Henry and Johnson. The ground represented in the diagram is irregular, consisting of a hill, the sides of which are covered by wood; the hill being cut by a ravine which was apparently near the northern border of the storm, or of that part in which the trees were thrown in the direction of its course. The

wood was of young hickories and black oaks, without undergrowth, but even here some irregularities were seen. The spiral growth of a few of the trees had led the proprietor of the farm to think, and speak, of the whole effects as produced by a whirlwind. He pointed out those cases, which were, obviously, seen to have resulted from the cause which I have just assigned. It will be observed in the figure, that of nine trees there represented, the two on the north side of the storm fell southward and eastward, one, *g*, points out its direction nearly, and five of the six of the south side are directed between N.  $10^{\circ}$  E., and E.  $40^{\circ}$  N. The breadth of the storm was here about 200 yards, and its direction about that of the line A, B.

We next repaired to a point where the destruction was reported to have been considerable, namely, to the farm of Mr. D. Polhemus, between two and three miles E.  $17^{\circ}$  N. from Mr. Garretson's. Here a very curious fact was developed, which I have attempted to represent in the sketch and ground plan figure 2, plate III. The building or shed attached to a large frame barn, and on the southern side of it, was moved during one part of the phenomenon to the west of north, and subsequently to the eastward. The posts (see *b*, figure 2) slipped from the stones, *a*, which supported them, when the building was first acted upon by the storm, and being carried northward and westward ploughed a furrow, *c*, in the soft surface of the ground, heaping up the manure, *d*, before them. Afterwards, being moved eastwardly, they formed another furrow, *e*, and a heap of manure, *f*, remaining in the position, *b*, when they were pointed out to us. As the first direction is nearly at right angles to that of the motion of the storm, the building being to the south of its axis, the conclusion is irresistible that there was, on the approach of the storm, a tendency to motion *towards* it. The second furrow shows a motion towards the receding storm. Why this building moved but in two directions, will appear from the protection afforded to the north east by a large barn, the strength of which enabled it to bear the tendency towards the moving meteor, without much injury. In figure 3, D is the shed, C the barn, and F G the probable direction of the storm, the probable axis nearly coinciding with that line. It is believed that the relative positions of the buildings there shown, are nearly correct; no particular pains were, however, taken on this score, a survey of the orchard to the east of the house, being the main object.

Of the trees in this orchard, figure 3, more than two-thirds suffered; being generally torn up by the roots. Of these there are two lying actually west of north, and seven thrown to the north of north-east; while the greatest amount of devastation is in the direction of the meteor, which passed over the western part of the orchard, the inclination of its path being about  $10^{\circ}$  N. of E. It is remarkable that some small trees, as *n* and *o*, were left standing, and were not much broken. Some large trees, as between *s* and *g'*, were also left. The former ones had probably sufficient flexibility to give way to the action of the storm without breaking; *c'*, *b'*, *a'*, *f'*, and *z*, were probably uprooted on the approach of the storm. The tree *y*, presents a curious case; it is broken into three parts, the middle one lies north, and



the two exterior ones are separated from it to the eastward and westward. It will be observed that the trees lying perpendicularly to the track of the storm, are not those furthest from the centre of that track.

While the trees on the southern edge of the storm were thrown generally northward and eastward, the few which were on the north side, were thrown to the southward. Thus at i' is shown a large black cherry tree, uprooted and lying nearly parallel to the side of the house A, while at k' and l' are groups of willows, the limbs of which were broken off, and thrown to the southward and eastward. There were no trees in the meadow to the north of the orchard, and east of the group k'.

We were told by Mr. Polhemus, that the orchard of a neighbour to the west of him had been prostrated, but did not consider it advisable to return upon that point, determining rather to follow the track of the storm towards Brunswick. The general direction of Brunswick from Mr. Polhemus's house is E.  $10^{\circ}$  N.

We explored the wood belonging to Mr. Polhemus, and eastward from his dwelling, where the marks of the tornado were next to be seen. As, however, nothing of special interest was developed, I have not thought it necessary to copy the drawing made from my notes. Passing through this wood, the track was marked through fields of grain and orchards, in which the trees were uprooted, and near buildings which suffered more or less from its action.

The next point of interest occurred, where we distinctly made out that the meteor did not maintain its position at the surface of the ground; a fact which has been before observed in regard to other tornadoes. After a slight damage upon the edges of a thick wood of black oak trees, the marks of destruction were not seen until traced upon a ploughed field, to the east of the wood, in which there were a few trees. These were uprooted, and the moist earth from the surface of the field was thrown against the trees of an adjacent wood.

The next diagram, figure 4, represents a very remarkable case, establishing conclusively the direction of the forces already pointed out in figure 2, but in a case less complicated than the former.

In a tolerably open wood, we lost all traces of the storm, but pursuing a general easterly direction, came upon a part of its track where the trees were broken near the top. A little further on they were broken nearer to the trunk, and at last uprooted. A survey of the exterior of a circular space, around which the trees were overthrown, gave the accompanying representation, figure 4. The round was traced by the directions of the trees; that is, having set out at one point, I arrived at it again, by following the indications afforded by the directions of the trees. In the mean time Mr. Espy explored the interior of the round, and pointed out to me a space where the tops of the trees were lying together. The evidence of a rush towards a central space is thus conclusive.

To generalize the results of this diagram, it will be seen, that with a few exceptions to be remarked upon directly, all the trees on the southern border of the circular space A, are thrown northward; those

to the north southward; to the east westward, and to the west eastward.

These exceptions are probably to be referred, generally, to the forward motion of the spout. Thus, while *c* is thrown to the west of north, a tree beside it, and many like *p* to the south of it, were carried in the general direction of the moving column. The same is true of trees to the north of *g* and *h*. In selecting the trees to be noted, I took care to put down cases which seemed anomalous, lest something of consequence should escape observation. The irregular positions of the tops of trees at *i*, seem to be sufficiently explained by their interference in falling. The tree *g* may have had its top carried northward in falling, and lies almost directly opposed to the directions of trees to the north of it; these trees being bent permanently, but not broken. Pursuing the track of the storm along *B C*, the trees were thrown in its general direction.

Passing forward to the east, we lost the traces of the storm, and when they appeared again, the circumstances seen in approaching figure 4 were repeated. Figure 5 represents the recurrence of the effects produced by the descending of the column to the ground. I did not think it necessary to go round, with the compass, that part of the circle which is turned in the general direction of the motion of the spout, but merely the other portion which presents the curious circumstance of trees thrown in a general direction opposed to that of the motion, proving conclusively, that a rushing wind from the westward will not explain the effects. The fatigue incident to the previous work, made me very willing to cut off all that seemed of doubtful utility.

The next position surveyed, was at and around the dwelling of Mr. David Dunn. The destruction here was terrible indeed. The dwelling house had been unroofed, and otherwise severely injured. A large barn and stable had been torn down, the outhouses prostrated, and all the trees around the dwelling uprooted or broken to pieces. The storm had passed from an adjacent wood, about one-sixteenth of a mile to the west. All this destruction had been accomplished and an entire calm taken place, in the time that Mr. Dunn ran from the front to the back door of his dwelling, a distance of about thirty feet. This excessive rapidity of motion was no doubt one of the causes why lives were not lost, in vain attempts to escape from the effects of the storm.

Mr. Dunn received us with great kindness, and gave every information in his power, without expressing weariness at our curiosity. Indeed it is but justice to say here, that we met with uniform courtesy and kindness, along the whole route of our inquiry, and experienced no case where those whom we addressed were unwilling even to leave their work, to point out to us matters worthy of attention. For this attention we beg leave thus publicly to return our thanks.

A general glance at sketch figure 6, will serve to show that the trees near the house were thrown inwards. No case occurs in which the trees are thrown outwards from the house. Many, however, further to the north and east of the house, and which are not represented

in the sketch, were carried in the direction of the storm. A closer examination will serve to show several interesting particulars.

Of twelve trees in the row A B, south and west from the dwelling, all but three were injured, and generally uprooted. The three not injured were young black cherry trees, two were of "medium size," and the other quite small. Six of the trees were thrown between N.  $4\frac{1}{2}^{\circ}$  W., and N. W., or *towards the approaching spout*. Three were thrown towards the house, namely, the one nearest to the house, and two furthest from it: all these are large trees. Of the trees around the house, all those uprooted or broken, except *q* and *k*, point towards the house, and these were evidently caught by the trees to the west of them. *s'* presents a curious case: the tree was broken off, and the fragment carried towards the west; then, by a subsequent force, laid in the position *s'*, E.  $7\frac{1}{2}^{\circ}$  S. The tops of *m*, *n*, and *w*, were lying together in a heap, and the limbs from the trees in this group, together with palings from a fence to the west of the house, and fragments of the outhouse, C, were strewed at *x*. *u* and *t* have received their direction probably from the onward motion of the spout, which heaped an immense mass of rubbish against the west side of the house, breaking it in, and destroying nearly every article of furniture in the south-west room. The house, and the area just described to the north of it, seem to have been the scene of this inward rush. The facts to prove that it was also an upward one, will be stated by Mr. Espy. The trees in a field to the north of the house, and beyond *u*, *t*, *s*, *o*, were carried eastward in the general direction of the storm; and in a field still further north, the rafters from the roof of the dwelling A were found.

Two rows of trees extended from the south side of the house to the road. These do not appear to have suffered as much as the row to the west of them. In the nearest position of the spout, they were in part protected by the house. The trees which were uprooted lie in directions extending over the sector between N.  $15^{\circ}$  W. and N.  $45^{\circ}$  E.; much the greater number of trees being thrown between north and north-east.

A tree at *d'* was thrown against a small porch to the north of east of it.

As the destruction to the eastward of this house renders it improbable that the axis of the spout did not touch the ground there, it seems to me that this inward rush indicates that the spout had its velocity *momentarily* checked at this point.

On the following day we examined a wood to the east of Brunswick and on the opposite side of the river Raritan. This wood is to the east of the position examined by professors Henry and Johnson, from which the debris inspected by them had been removed.

The case here presented was so complex, that I doubt much if we could have unravelled it without previous preparation. The irregularities encountered on the southern edge, see diagram figure 7, detained me so long, that I was only able generally to sketch the northern borders, the directions of the trees being, however, still taken with the compass. The inward direction of the forces is here well made



out, notwithstanding the confusion produced by the subsequent forward rush of air. While I was engaged in obtaining materials for this sketch, Mr. Espy penetrated further west into the wood and beyond it. He states that the marks on the trees indicate a downward motion of the spout at this place, more obscurely made out than in the other cases before described. The nature of the ground to the west of the wood was unfavourable to an exact determination of this point, but it is probable that the spout was raised, for a short distance, above the surface of the ground.

As far as the examination of the different diagrams has shown, I think it entirely made out that there was a rush of air, in all directions, at the surface of the ground, towards the moving meteor; this rush of course carrying objects with it; and that the meteor did not always extend to the surface of the ground, and when at the surface did not move uniformly either in velocity or in direction.

In figure 1 there is no motion towards the approaching meteor exhibited; and this appears generally to have been the case along its track when moving uniformly and reaching to the surface of the ground. The reason of this readily appears, for the air in front of it would hardly be in motion, the trees carried by it hardly bent, before the second and more violent action would prostrate them in the general direction of the motion of the meteor.

Figures 2 and 3 exhibit cases of this motion in both directions, towards the approaching and towards the receding meteor. But there is no evidence here that the spout was not moving along the surface. In the case of figure 2, the motions were registered by the effects upon the ground, and the easily uprooted trees shown in figure 3, fell in directions, with one exception, between  $10^{\circ}$  W. of N. and  $3^{\circ}$  N. of E.: the meteor moving about  $8^{\circ}$  N. of E., and to the north of the orchard containing the trees.

The disappearance of the track of the storm is first satisfactorily made out in the remarks subsequent to those upon figure 3. The effect of a second case of the sort is represented in figure 4, where around a circular space, in which the tops of the trees were found lying together, is a ring in which the trees generally point to the central space. At the outlet, where the storm moved on its track, the trees are found in the ordinary directions, and the same is true to the eastward of the place in which this descent of the spout occurred.

A second case of the same kind is represented in figure 5. At Mr. David Dunn's, the evidence is against such a descent having taken place at the dwelling-house, as shown by the row of trees to the south and west of the house, see figure 6, and by the fence, trees, and shrubs of the garden to the west of the house. Yet the dwelling appears as a centre, towards which objects to the north and east of it were thrown. To account for this I have supposed a momentary, and the evidence shows that it was merely momentary, pause or check in the velocity of the meteor. Such pauses were represented to us by many spectators to have taken place, and sometimes in cases where they could hardly have been deceived. In figure 7 is shown a case in which it

is doubtful whether the effects are those of a check of velocity, or of a descent of the spout; most probably both took place.

These effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the ground.

### References to the Diagrams on Plate III.

FIGURE 1.

*Wood of Mr. M. S. Garretson.*

- a. Tree uprooted,\* N. 20° E.
- b. Broken off, lies N. 10° E.
- c. Hickory torn up by roots with a sapling alongside, N. 38° E.
- d. Top of a black oak blown off, carried to E. 40° N.
- e. Hickory broken off about two feet above the root, lies E. 1° N.
- f. Black oak broken off at the root, E. 41° N.
- g. E. 15° N., about thirty yards from the north edge of the storm.
- h. The south east corner of Mr. Garretson's house bears W. 3° S. from this point.
- i. A sapling bent over and kept in place by other trees, E. 30° S.
- k. A sapling bent to E. 36° S.

- i. E. 3½° N.
- k. E. 18½° S.
- l. E. 25° N.
- m. E. 18° N. Tolerably straight. Shingles from barn, found at the foot of m. South-east angle of the barn bears W. 30° S.
- n. Tree standing.
- o. Low tree standing: small.
- p. N. 32° E.
- q. Broken, not uprooted.
- r. N. 27° E. Dead: bushy.
- s. Standing. High and stout.
- u. N. 24° E.
- v. Plum tree near, standing.
- x. N. 5° E.
- z. N. 9° W. Small, firmly rooted in north side.

y. Thick and bushy: broken off into three parts, the smallest of which points west of north, the next north, and the largest east of north; the bark is stripped off below the fracture.

FIGURE 2.  
*Outhouse of Mr. D. Polhemus.—Ground Plan.*

- a. A flat stone, on which the post b originally stood.
- b. Present position of the foot of the post.
- c. Groove made in earth to northward of a, by the post.
- d. A mound of manure heaped up at the end of the groove c.
- e. A second groove north of east in direction.
- f. A mound, heaped up by the post b two feet high.

FIGURE 3.

*Grounds of Mr. D. Polhemus.*

- A. Dwelling house of Mr. Polhemus, slightly injured.
- B. Outhouses not injured.
- C. Barn, shingles torn off, not many in number.
- D. Shed shown in figure 2.
- E. Open work corn crib, not injured.
- a. N. 12° E. Uprooted.†
- b. Tree uprooted, too crooked to determine its direction.
- c. N. 6° E.
- d. N. 27½° E.
- e. E. 20° N.
- f. Tree standing near the fence.
- g. E. 6° N.
- h. E. 3° N.

- a'. N. 4° E.
- b'. Same general direction as a'.
- c'. N. 2½° E. Small roots.
- d'. E. 22° N. Very large roots.
- e'. N. 10° E.
- f'. N. 10° W. A small tree near this, in the same row is untouched.
- g'. E. 35° N.
- h'. E. 3° N. Three trees at the south end of the row f' g' are standing.
- i'. A very large black cherry tree, uprooted, and lying nearly parallel to the house.
- k', l'. Groups of willows, the limbs and branches of which are torn off, and thrown to southward and eastward.

FIGURE 4.

*A Wood.*

- a. N. 40° E. Uprooted.
- b. N. 35° E. Several in the same general direction.
- c. N. 29° W. The top of a tree has fallen on c, and nearly at right angles to it.
- d. W. 12° N. Uprooted.
- e. W. 42½° N.
- f. W. 13° N.
- g. W. 4° N. It lies N. 15° W. from e, and about one-eighth of a mile from it.
- h. S. 23° W. One of the last trees near the edge.

\* The trees are uprooted unless the contrary is stated, or shown in the figure.  
† The directions of the arrows indicate those of the trunks of the trees.

- i. Top blown E.  $36^{\circ}$  N., large end foremost. Another top at right angles.
- k. Top blown off E.  $0\frac{1}{2}^{\circ}$  S.
- l. E.  $7\frac{1}{2}^{\circ}$  N. A tree near l is broken off and top lying to west, obviously could not go to eastward on account of the other trees.
- m. N.  $23^{\circ}$  E.

n. N.  $15^{\circ}$  W. Many large and small trees, not varying in direction  $5^{\circ}$  from the direction in which this has fallen.

o. Is the same as a. Being at once the point of departure and of termination. b was also examined and identified.

References to the Diagrams on Plate IV.

FIGURE 5.

A Wood.

- a. E.  $35^{\circ}$  S. Tall hickory broken off about fifteen feet from the root.
- b. S. also broken.
- c. S.  $31\frac{1}{2}^{\circ}$  W.\*
- d. W.  $9^{\circ}$  N. Uprooted. A tree near to d is broken off and carried in the same general direction.
- e. Broken off and carried W.  $18^{\circ}$  N. A tree near to this and west of north of it, carried in the same general direction.
- f. A large rotten oak broken off, lying W.  $36^{\circ}$  N. Its trunk at the base, fifteen feet from the fracture, measures six and a half feet in circumference.
- g. A broken tree lying over f and nearly at right angles to it.

FIGURE 6.

Dwelling and grounds of Mr. David Dunn.

- a. N.  $40^{\circ}$  E. A cherry tree. The west corner of the house is about one hundred feet off, and lies to N.  $42\frac{1}{2}^{\circ}$  E.
- b. N.  $20^{\circ}$  W. A cherry tree uprooted.
- c. Cherry tree of medium size unbroken.
- d. N.  $22^{\circ}$  W. A large cherry tree uprooted.
- e. N.  $19^{\circ}$  W. Uprooted.
- f. Small cherry tree standing.
- g. Large cherry tree N.  $4\frac{1}{2}^{\circ}$  W.
- h. Cherry tree of medium size, unhurt.
- i. N.  $10^{\circ}$  W.
- k. Black cherry tree N.  $13\frac{1}{2}^{\circ}$  W.
- l. N.  $23\frac{1}{2}^{\circ}$  E.
- m. Largest cherry tree in the row, N.  $10\frac{1}{2}^{\circ}$  E.
- n. Large pear tree.
- o. Broken off and cut since the storm.
- p. A small tree standing. A tree on the opposite side of the road is broken off, and the broken part lies to the northward.
- q. A large black cherry tree lies N.  $15^{\circ}$  W.
- r. Not taken.
- s. Broken seven feet from the ground, and has fallen against t.
- t. Not taken.
- u. A large black cherry tree N.  $18^{\circ}$  E.
- v. E.  $30^{\circ}$  N. Large black cherry tree, torn up and thrown from its bed.

- w. N.  $40^{\circ}$  E. Black cherry tree.
- x. N.  $3^{\circ}$  E. Smaller cherry tree.
- y. N.  $18\frac{1}{2}^{\circ}$  E. Largest size.
- z. Broken to north east.
- y'. Standing.
- z'. Broken.
- a. N.  $3^{\circ}$  E. Very large black cherry tree.
- b. Small tree not injured.
- c. Larger than b not injured. Small.
- d. Uprooted N.  $45^{\circ}$  E.
- e. Small.
- f. Medium size cherry tree. Not broken.
- g. Broken limbs to east. A black walnut (?) tree.
- h. Cherry tree broken.
- i. Pear tree uprooted.
- k. N. of house. W.  $4^{\circ}$  S. Small fruit tree fallen against l.
- l. Stripped of leaves.
- m. Pear tree uprooted, points, as shown in the figure, towards the house.
- n. Ditto.
- o. p. Broken fruit trees. Small.
- q. Broken off and lying against r.
- s'. Is the position of the broken part of s. It lies E.  $7\frac{1}{2}^{\circ}$  S.
- t. Large pear tree, pointing as shown in figure.
- u. Points to about ten feet east of the wash-house B. It is a broken apple tree.
- v. Broken pear tree, coated with dust on the north west side.
- w. Large cherry tree broken off E.  $27\frac{1}{2}^{\circ}$  S. Its top lies with those of m and n.
- x. A pear tree. Broken.
- y. A black cherry tree, uprooted and thrown against z. Lies in the line y z a'.
- z. Black cherry tree, dirt on the north east side of it. Broken on that side, its limbs lie parallel to the house.
- C, D. Two outhouses to east and west of z. The timbers of the eastern outhouse C, lie in the mass b', which contains the tops of trees, &c. The windows of D are broken on the east, one on the west side is forced in. Clap-boards are off in part near the ground on the north side.
- b'. A heap of rubbish left by the storm.
- Tops of trees k, l, m, &c., beams from C, &c.
- c. A tree lying as shown in the figure.

\* The trees to the directions of which the angles refer, unless when the contrary is stated, were uprooted.



d. To S. of house. A small tree broken and thrown against the porch H.

F. A fence to the west of the house prostrate, and in part carried against and into the west side of the house. All the trees and shrubs which were in this garden, are prostrate or broken.

FIGURE 7.

*A wood to the east of New Brunswick.*

b. N. 26° W. Two oaks close together, uprooted. Trees to N. 26° W. of b lie in the same general direction.

c. E. 9° N. Trees near c and to west of b lie, some directed as c, others as b.

e. E. 36° N. A small oak, which may have been deflected by the trees against which it has fallen.

f. Three trees, smallest N. 38½° E. The largest has possibly been deflected by the trees against which it has fallen: it rests N. 18½° E. One to the west of the other two is rotten; it lies N. 3½° W. Smallest and largest not wholly uprooted.

g. N. 16½° E. Uprooted. A tree to the south of this inclines to the east.

h. E. 40° N.

i. W. 18° N.

i' Two small trees uprooted, lying under i, N. 3° E.

k. Broken. Its top lies N. 10½° E. from the trunk. Crooked.

l. N. 6° E. The top of an oak. Broken off.

m. Top off. E. 32° N.

p. N. 16° W. Three oaks uprooted.

q. N. 30° E.

q'. to N. and E. from q. Broken, N. 35° E.

r. Two oaks uprooted, E. 36° N.

s. N. 23½° E.

t. N. 32½° E. Several others not 10° from this direction.

v. A broken oak, N. 44° E.

w. Top broken off and carried to north east. Direction of the stem of top N. 20° E.

x. N. 26° E.

y. N. 10° E.

z. Top carried to N. 39° W. Some trees near, lie to N. 40° E.

a. Lies S. 2½° E. Another, near it, is in the same general direction.

b. Nearly south. A rotten stump.

c. A sound tree broken to S. 35° W.

d. Uprooted to S. 36° W. Many like this to the east of it.

e. S. 28° W.

f. S. 14° W. This tree is north of the point a.

g. S. 12° W.

h. Very nearly S. 3° E.

i. S. 6½° W.

Trans. Amer. Philos. Soc.

[TO BE CONTINUED.]

## Practical & Theoretical Mechanics & Chemistry.

*Memoir on the Preservation of Timber.* By M. A. BOUCHERIE, M. D.  
*On the Method of Penetration.*

[CONTINUED FROM PAGE 185.]

After having determined the substances which were most efficacious in preserving wood, I had to seek for the means of introducing them deeply into it. The method which I sought was not only required to be complete in its scientific results, but it ought also to unite the conditions of quickness and economy indispensable to its application to the arts.

I first satisfied myself by numerous experiments upon different kinds of wood, plunging them into different liquors, that maceration, unless it was exceedingly prolonged, introduced the materials only to a very slight depth.\*

I then turned my attention to mechanical means, and not knowing

\* Wood plunged in saline solutions yields to them a part of its soluble matter, which forms combinations with the liquid outside of the mass, thus occasioning the loss of a part of the preserving substance, which we should always study to save.

In some experiments with salts of iron, I have seen my solutions pass into the state of a true mud.

of M. Breant's ingenious machine, I caused several imperfect apparatus to be constructed, from which I obtained no satisfactory results.

I succeeded no better in rarefying, by a regulated heat, the air included in the interior of the wood, and then plunging it at once into the solutions which I wished to introduce. By this method of operating, however, I succeeded in causing different liquids to penetrate various materials used in construction, of a very compact nature—thus I succeeded in introducing tar into stones and bricks to a great depth.

This want of success did not discourage me, and being possessed with the rational idea that it ought to be infinitely more advantageous to act upon wood in its green state, than to prepare them, after the time necessary for their complete desiccation had sensibly altered them, I began to inquire whether the force which determines the circulation during the life of the tree, did not continue after it was felled, and whether I could not employ this as an introducing agent, in order to penetrate the mass of the tree by different matters fitted to preserve it and give it new properties. I undertook some experiments in reference to this, and the success answered my hopes; I succeeded, in short, in discovering an infallible method of introducing into the very tubes which contain the alterable matters, substances which, by rendering them insoluble, prevent their decomposition and destroy their nutritive properties.

I was not aware at the time, of any examination directed to this fact. Since then, I have learned that experiments had been formerly made upon fresh plants, and young branches, in order to determine the course of the sap by the absorption of coloured vegetable solutions. These experiments were purely scientific, and before the development of the facts of which I am now about to treat, the fundamental idea had never occurred to any one of taking advantage of the vital force of plants in order to use it as a beneficial force, by the aid of which we should be able to introduce almost into the integral particles of the wood, certain matters which possessed the power of preserving it, and of giving to it new properties.

The following is the fact upon which my process is founded.

*If we cut a tree of great height, and immerse the foot of it, within a suitable time, in a saline solution, whether weak, or concentrated, a strong absorption is exercised by the tree upon the liquid, which thus penetrates the tissue, and soon reaches the highest point of the stem, and even the terminal leaves, if we are careful to furnish sufficient quantity of the liquid.*

Thus in six days, in the month of September, a poplar tree, ninety feet in height, and fifteen inches in diameter, the foot of which was immersed only eight inches into the pyrolignite of iron, at the temperature of eight degrees, was entirely impregnated by the liquid, of which it absorbed the enormous quantity of three and a half cubic feet.

Seeing the numerous applications of this new principle, I varied my examinations and experiments in a thousand different ways. I operated upon all the different varieties of trees which I could pro-

cure, at different seasons of the year, and with a considerable number of liquors of different natures. In the course of these researches I developed some curious facts, of the highest interest in vegetable physiology, the most obscure parts of which they illustrate. Not desiring to speak of intervascular penetration, except in reference to its applications, I reserve for another memoir, which I shall soon offer to the Academy, the facts relative to the internal organization of wood, its diseases, the course of the sap, &c. &c.

In order to give greater clearness to my observations, I shall divide this part of the work into paragraphs, upon each of the details of the process.

*I. On the means to be employed to effect the impregnation of wood in the most economical manner.*

In my first experiments, I raised up, by suitable means, trees which had been sawed off at their foot, and immersed their base in receptacles full of the liquor which I wished to introduce. The absorption was effected perfectly, but in regard to the quickness and economy of the work, there were great inconveniences in proceeding in this way, because the weight of a green tree of large diameter, is very considerable, and it requires not only powerful means to raise it up, but we must also find a strong resting-place to support it; but this resting-place can often be found only at a considerable distance from the tree which we wish to prepare. To overcome this difficulty, I examined whether the absorption did not go on equally in all positions of the plant, and finding that it was always equally strong, I decided to operate upon the tree whilst upon the ground; adapting very accurately to its foot a bag of water-tight stuff, which answered the purpose of a reservoir. In this way, I operated very many times with great success.

Afterwards I began to inquire whether I could not prepare a tree, whilst standing, by excavating a hollow in its trunk, and putting it, by suitable means, in communication with the reservoir filled with the liquid. In this way, I succeeded remarkably well, and by varying the nature of the liquids, and by multiplying the cavities for the reception of each one, I was enabled to impregnate the same trunk with different substances, and to produce the most varied results. I do not, at present, dwell upon this order of facts, which may, some day, become of importance, I will only remark that by this method of impregnation, the liquids are introduced, upwards and downwards, into all the sap-vessels, which have been opened, with this difference, that in an upward direction the column penetrated preserves its breadth to a very considerable height, whilst downwards it diminishes rapidly in advancing towards the roots.

I then sought to simplify this mode of preparation, and to render it more complete in its results, and in order to succeed, I adopted a new process, which has given me, already, excellent results. It consists as follows. After having stripped the tree of such of its branches as experience has taught me are not indispensably necessary to cause a strong absorption, I pierce it through and through, in the direction



of its greatest thickness, by means of an instrument, which bores a hole of three-quarters of an inch in diameter; into this hole I introduce a saw, which enables me to extend the opening in a line, to within about one inch of the surface. I thus open up the greater part of the sap-tubes of the stem, and nevertheless, leave sufficient upon two opposite points to sustain the tree in its vertical position. This being finished, I cover all the open parts with cloth covered with tar, which I fix firmly to it, and adapt to one of the circular openings, which I take care not to choke up, a tube which communicates with the reservoir.

*II. Is the absorbing force the same at all seasons of the year: or does it vary in each of them, according to the kind of tree which we are examining?*

My position has not enabled me to combine a sufficient number of observations to arrive at the whole truth upon this subject. I can only present a small number of facts, which show how interesting the general study of it will be, and to what unhopèd-for results it may lead us.

In general, winter is a season of repose for the vegetable circulation; but in no case is this repose complete in any species. I have convinced myself of this by experiments made upon oak, hornbeam, and sycamore, in December and February; I have seen, in the cold months, the liquids mount several feet, but never to so great a height as during the spring, summer, and autumn. Of these three latter seasons, the spring appears the least favourable for a complete impregnation, and the autumn has given the best results.

This fact is in contradiction to every thing which has been admitted heretofore. Botanists, in fact, consider the spring as the epoch of the year in which the movement of the sap is most active. This arises, probably, from not having made any distinction between the movement of the sap at the surface, and its movements in the interior of the tree.

I have reason to think that these movements do not take place at the same time, and I may present, in support of this opinion, some confirmatory facts. But the result to which I am led by them differs so far from that which has heretofore been adopted, that I fear I have mistaken them. I am now busy in repeating my experiments, and if, when varied, they confirm and illustrate that which I have already observed, I will record them in another memoir, which I propose to present to the Academy.

A remarkable exception to this law, which regulates the movement of the sap, presents itself. It is presented by those resinous trees which preserve their foliage green until spring, because in them the circulating movements are preserved during the winter. I have proved this fact by experiments made upon these trees in December, and in the first days of January; I have always been able to impregnate the whole of their trunks at this season of the year. This fact ought to have been known before-hand, since the permanence of the fresh and green state of the leaves, which always have a tendency to

dry up, and then to fall, could only be caused by their constantly receiving liquids which the movement of the sap alone could carry to them.

But although the movement of the sap in this class of trees is prolonged much later than in other species, its re-appearance, after it has ceased to exist, is much more slow.\*

I have observed that this new, yearly, and deep-seated circulating movement had not yet shown itself in June, and it was in confirming this fact that I discovered another, which I think worthy of mention.

Upon the 25th of May, 1839, after cutting a pine in bud† of eighteen inches in diameter, and of a great height, I suspended it to a neighbouring tree; I dipped its lower extremity into a reservoir full of pyrolignite, and I suffered the experiment to continue for eight days. When this time had elapsed, I was not a little surprised to find that the level of the liquid in the reservoir had scarcely fallen. I felled the tree, and upon examining it, by cutting in at different points, I found that, in general, it had absorbed nothing, even at its lowermost parts, but that for a thickness of one inch, and to an extent of forty feet, the face which looked towards the south-east was well impregnated. This fact, besides demonstrating that the sap is but slowly put in motion in the pine, renders evident the influence of exposure, which had been before remarked, and accounts also for the greater development which is generally presented upon that side of the tree which faces the south-east.

*III. Is the absorption more active and energetic, in proportion as the tree is more vigorous, its branches more numerous, and its foliage more abundant, and better developed?*

In a practical point of view, it was interesting to determine whether all the branches were indispensable for effecting the impregnation; for if it was found that they were not necessary, it became possible to remove isolated trees to a central place, in order to prepare them there. I have assured myself, by several experiments, that the greater part of the trunk of a tree can be penetrated, notwithstanding the removal of almost all of its branches. The terminal foliage of the tree must always be preserved.

*IV. What time may be suffered to elapse between the cutting and the preparation of the tree, preserving always proper conditions for the penetration?*

This time varies with the season of the year, and the species of tree. At the end of September, a pine tree, sixteen inches in diameter, was not dipped into the liquid until forty-eight hours after it was cut, and nevertheless, was perfectly impregnated. In June, the same result took place with a sycamore tree, which had been cut thirty-six

\* The movement of which I speak is that general movement which permits the introduction, to a great depth, of the liquids which are presented to the base of the tree; it must be carefully distinguished from that which converts the buds into leaves, and furnishes nutriment to all the spring-shoots. This latter movement exists in the pine as early as the month of April.

† Pin gemmé.

Fig. 1

WINDMILL on SP. M. & ALABAMA RIVER

Scale size of Fig. 1

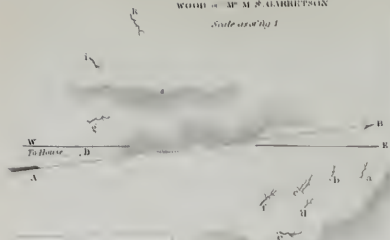


Fig. 2  
OUT HOUSE of R. D. POLHEMUS.



Fig. 3

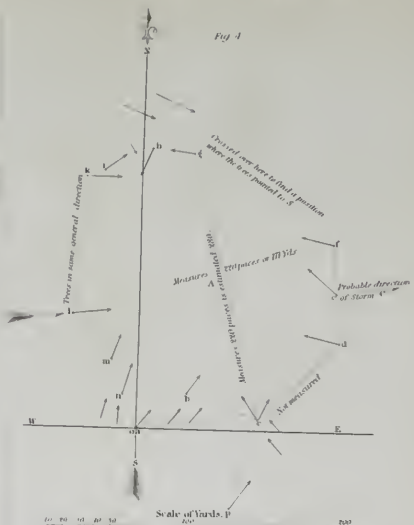
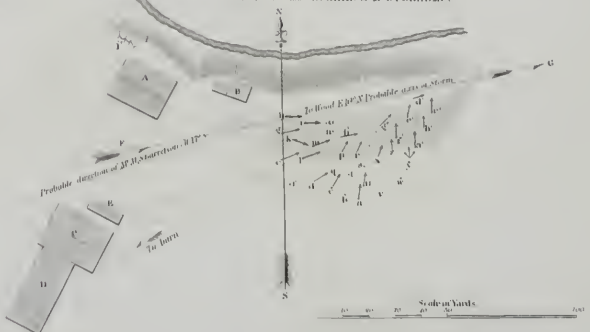


Fig. 3

DWELLING and ORCHARD on SP. M. & ALABAMA RIVER





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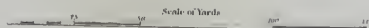
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Fig 6  
DWELLING HOUSES OF MEDDEN



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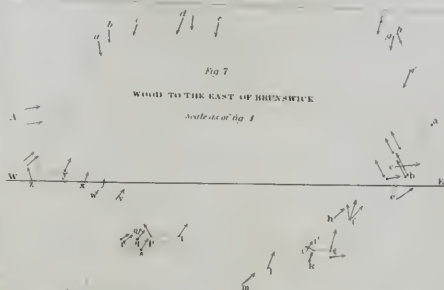


Fig 5



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hours. Having at my disposal but a small number of trees, I did not wish to run the risk of waiting longer; but it is probable that even after a longer delay, I should have been able to impregnate, if not the whole length of the tree, (which is never of any use,) at least so much of it as is useful in building.

In all cases, the sooner we commence operations, after the cutting, the stronger is the absorption. It decreases rapidly after the first day, and is generally scarcely sensible upon the tenth day. These ten days are sufficient for a complete impregnation when we operate under favourable circumstances. In some cases I have observed that in seven days the liquor has risen to from 90 to 100 feet. The experiment was made upon a poplar.

*V. Are the quantities of different liquors, which can be introduced in this way, considerable? Is the absorption of neutral liquids more abundant than that of acid or alkaline solutions?*

Of all the secondary facts which arrange themselves around the primary facts of absorption, and are the consequences of it, this is the most remarkable. The quantity of liquors introduced is really enormous. A sycamore tree of one foot in diameter, absorbs, in seven days, nearly ten cubic feet of chloride of calcium, at fifteen degrees, and a tree of the same kind, in the same space of time, dried up a reservoir which contained seven cubic feet of pyrolignite of iron, at 6° Fahrenheit. With other species I obtained similar results, and always with quickness when I operated under favourable circumstances. *Apriori* these remarkable facts could not have been anticipated. Every thing would have induced us to believe, on the contrary, that the vitality of the vessels would be diminished by the contact of liquids so different from those which they ordinarily convey, and that the consequence would be the stoppage of the absorption. Experiment has shown that this is not the case. But let us cite more precise results.

Upon the 5th of August I dipped the extremity of a sycamore branch in chloride of calcium, (muriate of lime,) at 15°. At that time it weighed 2620 grammes—having finished the experiment upon the 13th, I found that it had absorbed 2000 grammes of the chloride, and its weight was reduced to 2466 grammes.

A second experiment, made also on the 5th of August, upon sycamore, gave me similar results. The branch weighed 2880 grammes at the commencement of the experiment; upon the 13th, it presented the same weight, and had absorbed 2430 grammes of chloride of calcium. A third branch of sycamore, weighing 4000 grammes, had absorbed, in eight days, only 880 grammes of pyrolignite, at 8°. In this case the absorption of the pyrolignite was relatively much less than that of the chloride of calcium. Every thing leads us to believe that this result is due to the fact, that acting as an astringent this salt contracts the vessels, shrivels them in some way, and thus materially diminishes their capacity—the horny state of the leaves, (*raccornissement*), which is always seen, indicates an action of this kind, which

is never seen when we operate with chloride of calcium.\* In this latter case, on the contrary, the leaves remain soft and flexible, even after being left to themselves for two years.

The size of the molecule of the body which we wish to introduce, certainly plays a remarkable part. It would, perhaps, not be impossible to measure it comparatively, by presenting it to the absorbing action of different kinds of wood, and a success of this kind would open a new scientific path, and offer to analysis a method for the perfect separation of bodies, which, heretofore, we have only been able to study after they have undergone a change in their nature, brought about by the means used to isolate them.

In order to determine the quantities of different substances absorbed, I repeated the weighings, of which I have just spoken, a great number of times, and always obtained similar results for the same species of trees. The same materials have always been absorbed in great volume, or always in but very small quantities. The neutral salts have always been found in the first class, and all acid and alkaline salts in the latter.

In order to determine the relation existing between the quantity of matter introduced into the branches, and that absorbed by the trunks of the trees, I had recourse to the incineration of these different parts, and thus assured myself that the differences were very trifling.

[TO BE CONTINUED.]

### *Metallic Relief Engraving.*

Take a tablet of plaster of Paris, and, having heated it, apply wax for absorption to all the faces, save that on which you intend your drawing to be, and to that one apply your drawing, executed with lithographic ink, on lithographic transfer paper. Let the side of the tablet on which is the transferred drawing, be now dipped in weak acid and water, and then permitted to absorb a solution of sulphate of copper. By electro-metallurgy a deposition of copper can be made on all parts stained with the sulphate. Ere this coating be too thick, let the tablet be removed from the vessel in which this last operation has been carried on, washed *carefully*, dried, and a mixture of isinglass and gin be poured on it; its redundancy be gently blotted off with blotting-paper till the surface be level (*i. e.* the copper lines and isinglass cement be of the same height:) again, let the deposition take place, and again its succeeding operation; after which let common

\* I will here remark that the modifications which the leaves present, under the influence of different re-agents absorbed by their stem, enabled me to measure, with great accuracy, the poisonous properties of different substances. Thus having plunged branches of poplar of the same size, taken at the same time from equal heights upon the same tree, into vessels containing water, the chlorides of calcium and sodium, pyroligneous acid, sulphuric, hydrochloric, and arsenious acids, and the sulphates of zinc, iron, and copper, and the deutochloride of mercury, I observed that the absorption of the five first liquors continued to go on, by the aspiration of the leaves, which remained healthy, whilst in the other solutions the absorption had, for a long time, ceased in the branches, the leaves being faded and withered.

black lead be rubbed over the whole surface; and the deposition being renewed, a copper mould, from which a type metal block may be subsequently cast, is now formed.—*Another method.*—Draw with a pen dipped in warm isinglass coloured cement, and when your drawing is dry, for an instant expose it to steam, and then coat it with leaf gold. Proceed by electro-metallurgy, as in last method, and no cast is necessary.

Athenæum, Feb.

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*Electrotype.*

M. Kobell, of Munich, presented some engravings through M. Brongniart to the French Academy, which were produced by a modified process of his own. Upon a well polished plate of copper, or silver, he executes a painting of the subject to be engraved. The colour which he employs is oxide of iron, pounded with essence of turpentine, and mixed with a certain quantity of the same essence thickened by standing, or, what is equally good, with a solution of the resin of Dammera in the essence of turpentine; he sometimes adds formate of silver. This painting is obviously monochromous, and the variety of tints is produced by the different thicknesses of the colour applied upon the plate of silver; so that the lights are given by the metallic surface, and the half tints and the shades by the greater or less thickness of the colour. When the painting is well dried and adherent to the plate, it is to be deposited in an electrotype apparatus, in order to receive the deposit of copper, which takes place immediately upon the parts not covered by the painting, more slowly upon those which are only covered by a thin layer, and more tardily still upon those parts where the thickness is greatest. After several successive applications, when the thickness is sufficient to support the action of the copper-plate press, the deposit is to be separated from the plate, and the former, if any remain adherent, may be disengaged from the painting, by washing with ether; we have then a mould of the painting, executed in relief upon the silver plate; and we may conceive that if we take an impression by the ordinary copper-plate press, the colour deposited upon the paper will possess the thickness of the original painting, and will be faithfully re-produced.

Ibid, Dec

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*Distinguishing Signal for Steamboats.*

The inventor is Mr. Francis Melville, who, from a praiseworthy desire to promote the general safety, has devoted much of his time to the subject. Mr. Melville's plan is to place in front of the funnel of the steamer a lamp, with a clear light, and a strong reflector, having an external sliding cover attached to its face, so fitted as completely to obscure the light within, but to be made to move up and down the whole length of the lantern by means of a rod affixed to a small lever power connected with the engine, so that the motions or alterations of the slider would be at the rate of twenty in a minute. At the bottom is to be added a flat sole, made so as to carry the rays of light



completely over the side of the vessel, in order that the reflection from any object on deck may not interfere with the pilot. By means of this simple apparatus, a signal will be produced perfectly distinct from any other known in navigation, and by means of it a steamer will, at the first sight, be known from any other vessel. Though the exhibition which we had an opportunity of observing was necessarily imperfect, (being displayed from a window,) enough was, nevertheless, witnessed to show at once the perfect practicability and adaptation of the signal to the purpose intended.—*Glasgow Argus.*

London Railway Mag.

*Meteorological Observations for August, 1841.*

| Moon.                                               | Days | Therm.    |        | Barometer. |        | Wind.     |            | Water fallen in rain. | State of the weather, and Remarks. |
|-----------------------------------------------------|------|-----------|--------|------------|--------|-----------|------------|-----------------------|------------------------------------|
|                                                     |      | Sun rise. | 2 P.M. | Sun rise.  | 2 P.M. | Direction | Force.     |                       |                                    |
|                                                     |      |           |        | Inch's     | Inch's |           |            | Inches                |                                    |
|                                                     | 1    | 60        | 67     | 29.76      | 29.85  | N.        | Mod. rate. | .10                   | Rain—cloudy.                       |
| ☉                                                   | 2    | 60        | 78     | 30.05      | 30.00  | E         | do.        |                       | Clear—do.                          |
|                                                     | 3    | 62        | 80     | .20        | .15    | S.E.      | do.        |                       | Clear—do.                          |
|                                                     | 4    | 63        | 83     | .07        | .07    | W.        | do.        |                       | Cloudy—clear.                      |
|                                                     | 5    | 72        | 75     | 29.90      | 29.90  | S.        | do.        | .45                   | Rain—drizzle.                      |
|                                                     | 6    | 61        | 79     | .85        | .85    | W.        | do.        |                       | Clear—do.                          |
|                                                     | 7    | 64        | 80     | .86        | .90    | W.        | do.        |                       | Clear—cloudy.                      |
|                                                     | 8    | 66        | 80     | .95        | .95    | W.        | do.        |                       | Clear—lightly cloudy.              |
|                                                     | 9    | 70        | 80     | .90        | .90    | S.W.      | do.        |                       | Cloudy—do.                         |
| ☾                                                   | 10   | 71        | 78     | .95        | .95    | E.        | do.        |                       | Cloudy—rain.                       |
|                                                     | 11   | 72        | 78     | .90        | .91    | S.W.      | do.        | 3.70                  | Rain—do.—rain in night.            |
|                                                     | 12   | 16        | 75     | 30.01      | 30.02  | SW        | do.        |                       | Cloudy—do.                         |
|                                                     | 13   | 66        | 75     | 29.95      | 29.95  | W.S.      | Caln.      |                       | Cloudy—do.                         |
|                                                     | 14   | 65        | 80     | .90        | .95    | S.E.      | Moderate.  |                       | Cloudy—do.                         |
|                                                     | 15   | 67        | 77     | 30.10      | 30.14  | E.        | do.        |                       | Cloudy—lightly cloudy.             |
| ⊗                                                   | 16   | 62        | 77     | .20        | .20    | E.        | do.        |                       | Cloudy—lightly cloudy.             |
|                                                     | 17   | 60        | 78     | .10        | .03    | W.        | Caln.      |                       | Cloudy—partially cloudy.           |
|                                                     | 18   | 64        | 80     | 29.96      | 29.96  | S.W.      | Moderate.  |                       | Lightly cloudy—do—do.              |
|                                                     | 19   | 62        | 79     | .95        | .90    | W.        | do.        |                       | Partially cloudy—clear.            |
|                                                     | 20   | 64        | 83     | .91        | .90    | S.W.      | do.        |                       | Clear—lightly cloudy.              |
|                                                     | 21   | 71        | 85     | .91        | .90    | S.W.      | do.        | .39                   | Partially cloudy—rain.             |
|                                                     | 22   | 70        | 75     | .85        | .86    | S.W.      | do.        | .25                   | Cloudy—rain.                       |
| ☾                                                   | 23   | 61        | 71     | .85        | 30.04  | N.E.      | do.        |                       | Lightly cloudy—clear.              |
|                                                     | 24   | 62        | 75     | 30.14      | .20    | E.        | do.        |                       | Partially cloudy—clear.            |
|                                                     | 25   | 58        | 76     | .21        | .16    | S.E.      | do.        |                       | Lightly cloudy—clear.              |
|                                                     | 26   | 59        | 70     | .05        | .00    | S.        | do.        |                       | Cloudy—rain.                       |
|                                                     | 27   | 66        | 75     | 29.94      | 29.84  | N.E.      | do.        | .50                   | Rain—cloudy.                       |
|                                                     | 28   | 70        | 77     | .85        | .90    | E.        | do.        | .73                   | Fog—rain.                          |
|                                                     | 29   | 72        | 82     | .97        | 30.00  | W.        | Caln.      |                       | Cloudy—clear.                      |
|                                                     | 30   | 69        | 76     | .98        | 29.96  | S.E. S.   | Moderate.  | .45                   | Thunder shower—flying clouds.      |
|                                                     | 31   | 67        | 78     | .85        | .85    | W.        | do.        |                       | Clear—do.                          |
|                                                     | Mean | 65.64     | 77.58  | 29.97      | 29.97  |           |            | 6.57                  |                                    |
| Thermometer.                                        |      |           |        |            |        |           |            |                       |                                    |
| Barometer.                                          |      |           |        |            |        |           |            |                       |                                    |
| Maximum height during the month, 85.00 on the 21st. |      |           |        |            |        |           |            |                       |                                    |
| Minimum " " 58.00 " 2.th.                           |      |           |        |            |        |           |            |                       |                                    |
| Mean 71.61                                          |      |           |        |            |        |           |            |                       |                                    |
| 30.20 on the 3rd, 16th, 24th, 25th.                 |      |           |        |            |        |           |            |                       |                                    |
| 29.76 " 1st.                                        |      |           |        |            |        |           |            |                       |                                    |
| 29.97                                               |      |           |        |            |        |           |            |                       |                                    |

CORRECTION.

In the article on Embankments of Earth, published in our last number, page 168, instead of general formula

$$\frac{\left(\frac{60}{\frac{a}{100} + 4}\right)^b}{f} = x \quad \text{read} \quad \frac{\left(\frac{60}{a+4}\right)^b}{f} = x.$$

## METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

APRIL, 1841.

[illegible]





**JOURNAL**  
OF  
**THE FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**

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NOVEMBER, 1841.

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**Civil Engineering.**

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*Extracts from the Treatise on Geodesy, by L. B. FRANCEUR. Translated by W. H. EMORY, Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 224.]

*On the Measurement of Bases.*

The measurement of a distance appears the easiest of all geodesic operations, whereas, in fact, it presents the greatest difficulties when great precision is required. It is not sufficient, as in ordinary topographical operations,\* to estimate the base by stepping it off, or measuring it with a chain, because the slightest error committed, rapidly increases when the sides of the triangles, composing a series, are obtained from it by calculation. When a base is to be measured, a piece of even ground is selected, which is clear and nearly level, and of about 10,000 metres, [nearly 11,000 yards,] in length. A right line is then traced on it, with stakes placed vertically in the ground. The ends of the stakes which go into the ground

\* M. Moynet made various experiments in the Island of Elba, to ascertain the error from measuring with the chain, and he found an error of only 56 centimetres, [22,04776 inches,] in a base of 5165,82 metres, [about 5,600 yards.] The base was that of the Castello light-house.

When a sketch of a country is made in the presence of an enemy, distances are measured by pacing. The length of each pace varies with the person making it, and is determined by experiment. It is usually three feet.

Distances are sometimes measured by the report of a cannon, which travels 180 toises, [1180.25 feet,] in a second, in calm weather. This manner of estimating distances, however, is very defective.

are shod with iron, and the other ends are painted black. To facilitate the alignment the engineer makes use of a theodolite, or repeating circle, by placing it in such position that the axis of the tube of the telescope will revolve in the vertical plane passing through the stakes.

The line being established with precision, rods of a known length are used to measure it. Two rods of equal, or nearly equal length, are made use of, and the mean between them is taken as the length of each. They are placed along the stakes, end for end, and are moved in succession.

122. Wood is the material usually preferred for making these rods, as its expansion is chiefly in the transverse section, and its length is not materially increased by heat. They are preserved from the effects of moisture by being soaked in boiling linseed oil, and varnished. To prevent them from warping they are made and put together as represented in figure 68. Their precise length is known by submitting them to a standard, hereafter described. Metallic plates are fitted to each end of the rods to prevent them from chafing, and to ensure more perfect contact. Sometimes a nail with a convex head is driven in the ends of each rod, and contact is produced by bringing together these two segments of a sphere. In this case, the length of each rod is the distance between the two extreme points of the convex surfaces.

123. The rod is brought into a horizontal position by being placed on a board, shorter than itself, supported by two solid tripods. The platforms of these tripods, upon which the board rests, is elevated, or depressed, by means of prismatic rods worked by screws. The measuring rod is moved about on the board, until fixed in its position, on rollers.

When the ground is uneven, or sloping, one of the rods will be lower than the other, and the two ends are then placed in the same vertical line by being brought in contact with the delicate thread of a plumb line, the weight being immersed in water to prevent it being moved by the wind. This means of adjusting the ends of the rods is, in fact, better than the first, because it is almost impossible to avoid producing some *recoil* when they are brought in contact with each other. It is necessary, in this case, to add something for the thickness of the thread of the plumb line, a quantity apparently insignificant, but which amounts to something when repeated as many times as there are lengths of the rod in the distance to be measured.

124. There is another contrivance frequently made use of, by which the contact between the ends of the rods is easily effected. It is a small rule, called the *tongue*, which moves along two grooves cut in the rod, and is worked by means of a delicate rack and pinion. It

carries a vernier, which slides along the divisions of equal parts marked on the rod, by which the observer can read the length it is made to protrude from the rod. Then the total length of the rod will be its length as measured under the standard, plus the length which the tongue protrudes. The rods made use of to measure the bases of Melun and Perpignan, were constructed in this manner. By the aid of a magnifying glass the length of the rod can be read to the one hundred thousandth part of a toise, [.0007874 inches.] For a more detailed account of this contrivance, see *la base du Système Métrique et la Géodesie* of Mr. Puissant.

125. The improved perpendicular, or mason's level, being more convenient than the spirit level, is made use of to adjust the rod in a horizontal position. The sides  $AC$ ,  $AB$ , are of equal length, and form an isosceles triangle  $ACB$ , and are kept in position by the metallic arc  $aEb$ . An alidade  $CD$ , carrying a vernier, is suspended from the centre  $C$  of the arc, and revolves about it. The arc is divided into degrees, and by the aid of a vernier a minute can be read upon it.

A spirit level  $cf$  is fixed perpendicularly to the alidade, upon which equal divisions are traced and numbered from the centre, by which it can be seen when the bubble is in the centre. The zero of the graduation of the arc  $ab$  is also at the centre  $E$  of the arc.

The instrument is so constructed that when placed upon a horizontal plane  $AB$ , the alidade is at the zero point of the graduation, and the bubble is in the middle of the glass. When it is turned end for end the same conditions should be fulfilled.

Something might be said of the tangent screw attached to the alidade, and other details in the construction of the instrument, but they can be easily imagined. If, however, a more detailed description is desired, it can be found in vol. ii, p. 9, of the *Système Métrique*.

126. As much time is lost in levelling the rods, it is better, when the inclination does not exceed two or three degrees, to leave them as they are, and measure the inclination, and then reduce the rod to the horizon by calculation, that is, calculate its projection on a horizontal plane. The inclination is measured by reading the graduation indicated by the alidade, then turning the level end for end, and reading the indication in this position also. Half the sum of these indications is the inclination of the rod.

127. *The reduction of the rods to the horizon.*—Let  $CB$  (fig. 56,) be the rod,  $CA$  its horizontal, and  $AB$  the vertical projection, and  $\theta$  the angle of inclination. Knowing  $AB$ , and the angle  $C$ , we can find the sides  $CA$ ,  $AB$ . The triangle  $ABC$  gives  $CA = CB \cos \theta$ . But  $\theta$  is a very small angle, and the value  $CA$  cannot be calculated



with sufficient precision; we therefore obtain it by finding the excess ( $x$ ) of C B over C A.  $x = C B - C A$ ; and we have  $\cos \theta = 1 - \frac{1}{2} \theta^2$ , nearly, from which we get  $C A = C B (1 - \frac{1}{2} \theta^2)$  and by calling  $C B = L$ , we get  $x = \frac{1}{2} L \theta^2$ . Now by substituting for the arc  $\theta$  its value expressed in its number of minutes we have

$$x = -\frac{1}{6} L (2\theta)^2 \sin^2 1' = -P L (2\theta)^2.$$

P being substituted for the constant  $\frac{1}{6} \sin^2 1'$ . In the same manner we find for the difference in height A B,

$$y = L \sin. \theta = \frac{1}{2} L (2\theta) \sin. 1'.$$

The levelling instrument makes known the angle  $2\theta$  by turning it end for end, and taking the sum of the inclinations, and the calculations are very easy. The logarithm of the constant  $P = 8.0243622$ ; and  $\log. (\frac{1}{2} \sin. 1') = 4.1626961$ . The arc  $(2\theta)$  is expressed by its number of minutes.

The calculation is much abridged by constructing tables giving the values of  $x$  and  $y$  for every inclination  $(2\theta)$  of the rod.

128. *Correction for temperature.*—When the rods are metallic the change of temperature in the morning and evening produces a change in the length which must not be neglected. The temperature of the rods is noted at those times when there is the greatest variation, and the mean between these extremes is assumed as that of the rods for the interval which elapses between the two observations. For the purpose of noting these changes a thermometer is sunk in the rods.

In the rods used for the French triangulation the thermometers were metallic, and fitted to a brass rule, which slid lengthwise into the rods, and were held there by two grooves. One of the ends of the rule forming the back of the thermometer was fastened to the rod by a screw, or by soldering, while the other was free. As the metals of the rods and thermometers were different, one being of platinum, and the other brass, their expansion was not the same for the same variation of temperature. At a certain degree of temperature, two marks, one on the rod, and the other on the thermometer, coincided, and they ceased to do so as soon as the temperature changed. By the aid of a magnifying glass, and divisions of equal length marked on the metal, the observer was enabled to read the excess of expansion of one metal over the other, and consequently the variations of temperature. The degrees of temperature were marked on the thermometer, and could be read with facility. The manner of calculating the lengths corresponding to the changes in temperature will presently be explained.

It was important that the rods should be sheltered from the sun, and for this purpose a kind of wooden roof was placed on the levelling

boards, with vertical sights at each end by which the rods were placed in the required direction.

To avoid errors, each reading of the tongue, the metallic thermometer, and of the inclination of the rods, is made twice. The results are noted in two separate books, and compared before proceeding to a new measurement.

129. *The measurement of the rod by the standard.*—To determine the exact length of the rods it is necessary to compare them with some other known length. For this purpose, an instrument called the *comparing rod*, is used, which, by magnifying them, shows the smallest differences in length between two rods placed one on the top of the other, and abutted at one extremity against a fixed point. For a detailed description of this instrument see the *Système Métrique*, vol. iii, p. 464. In obtaining the length of rods by this standard, the nature of their substances, and their temperature, must be taken into consideration.

131. It has been ascertained that for a change of  $1^{\circ}$  of the centigrade the length of the rod varies a quantity  $a$ , shown by the following table.

|                      |   |   |   |                    |
|----------------------|---|---|---|--------------------|
| Platinum,            | - | - | - | $a = 0.0000085655$ |
| Brass,               | - | - | - | $a = 0.0000187785$ |
| Wrought iron,        | - | - | - | $a = 0.0000122045$ |
| Steel, not tempered, | - | - | - | $a = 0.0000107915$ |

*This is called the linear expansion.*—Thus a metre of brass, in undergoing a change from  $0$  to  $100^{\circ}$ , is increased in length  $0.00187785$ , or nearly two millimetres, [ $0.07874$  inches English.] This is a quantity too large to be neglected.

Suppose  $l$  to represent the length in metres, toises, feet, &c., of a metallic rod at a given temperature. If the thermometer shows  $t$  number of degrees, (centigrade,) we have the elongation for every unit of measure by the proportion  $1^{\circ} : a : t : at$ ,  $a$  being the elongation for one degree taken from the table. Thus the length corresponding to  $t$  degrees is increased  $a t l$ , and becomes

$$L = l(1 + at) \quad . \quad . \quad . \quad . \quad (1)$$

131. FIRST CASE.—When the rod is of wood, and the standard of metal, we commence by calculating the length  $L$  of this standard for the actual temperature, knowing its length  $l$  at zero. The number denoting  $l$  is usually engraved on the standard. Then if the wooden rod is made of the same length as the standard,  $L$  will express its length. If it is not the same length, the difference is shown by means of the apparatus of comparison, and this difference added to, or subtracted from

$L$ , gives its length, which, as we have before observed, is invariable. The number denoting the length is then inscribed on the rod.

**SECOND CASE.**—If the rod and standard are both of the same metal there is no calculation to be made. If they are also of the same length,  $l$ , that of the standard at zero is engraved on the rod. When they are of different lengths, the difference  $\delta$  is measured by the comparing apparatus, and  $l + \delta$  is then the length of the rod at zero. In this case the actual temperature is not considered.

**THIRD CASE.**—We suppose the rod and the standard of different metals, and cut to the same length at a certain temperature  $t$ . When the temperature of the standard is reduced to zero its length becomes  $l$ , and the rod becomes of an unknown length  $x$ , which it is required to find. By equation (1,) we know in a change of temperature from 0 to  $t$  degrees centigrade the length of the standard and the rod will become :

$$\begin{array}{llll} \text{For the standard,} & - & - & - & l(1 + \alpha t), \\ \text{" rod,} & - & - & - & x(1 + \alpha' t) \end{array}$$

$\alpha$  and  $\alpha'$  expressing the linear expansion for a unit of measure in the two metals respectively. As both rods are then equal, we have

$$l(1 + \alpha t) = x(1 + \alpha' t)$$

from which we get

$$x = l \left( \frac{1 + \alpha t}{1 + \alpha' t} \right)$$

By developing this equation, and neglecting the terms of the second order, we have for the length of the rod at zero,

$$x = l[1 - (\alpha' - \alpha)t] \quad (2)$$

Its length at any given temperature  $t'$  of the centigrade will be

$$l' = x(1 + \alpha' t') \quad (3)$$

and if the rod is not cut exactly the length of the standard its length will be  $x + d$ ;  $d$  being the difference of the two.

This value  $x + d$  is the one marked on the rod, and is that given to  $x$  in equation (3). When a line is measured with this rod, under a temperature  $t'$ , given by the centigrade thermometer, it is necessary to calculate its length  $l'$  by equation (3),  $\alpha'$  being the constant corresponding to the metal used.

132. This method is subject to the inconvenience of giving a value to  $l'$  (the length of the rod,) containing a fractional expression, because the length of the standard  $l$  is a whole number, (usually four metres.) To reduce this to an expression containing no fractions, it would be necessary to diminish the rod by a quantity equal to  $(\alpha - \alpha')t$ , and then at zero it would be of the same length  $l$  as the standard. But as this diminution would be difficult to make, and as an addition would be impossible, the following expedient is resorted to.



Suppose that the rod and the standard at a given temperature  $t$  are of the same length; namely,  $L = l(1 + \alpha t)$ .

When the temperature falls to  $T$ , that is to say, decreases  $t - T$ , the rod will diminish  $L \alpha' (t - T)$  and its length will be

$$L [1 - \alpha' (t - T)] = l(1 + \alpha t)(1 - \alpha' t + \alpha' T)$$

Now find what should be the temperature, in order that the rod may be of the same length  $l$  as the standard at zero. To do this make the above value equal to  $l$ , and by neglecting terms of the second order we have

$$\left. \begin{aligned} \alpha' T &= (\alpha' - \alpha) t, \\ T &= \left( \frac{\alpha' - \alpha}{\alpha'} \right) t = \left( 1 - \frac{\alpha}{\alpha'} \right) t \end{aligned} \right\} \quad . \quad (4)$$

The length of the standard  $l$  is then marked on the rod, and also the temperature  $T$ , at which the rod assumes this length.

To get the length  $l'$  of the rod at any other temperature, equation (3) is used. In this case  $t'$  is the excess of the actual temperature over  $T$ .

133. Suppose, for example, that the standard is of platinum, and is five metres at zero, and that the rod is of brass, and cut the same length when the thermometer is  $100^\circ$ . We have then  $l = 5$ ,  $\alpha' - \alpha = 0,000010213$ , and the length of the rod at zero will be  $x = 4,999948935$ . If we find any inconvenience from making use of this fractional number, ascertain under what temperature the rod is five metres in length. Suppose it to be  $T = 5^\circ,44$ , we then mark on the rod five metres and  $5^\circ,44$ . The result, of course, will be the same in either case.

Now suppose we have ascertained a distance to be 2000 times the length of the rod just described, the temperature being  $18^\circ$ , we can find the total distance in two ways, either by making equation (1),  $l = 4,999948935$ ,  $\alpha = 0,0000187785$ , and  $t = 18$ , or by taking equation (3) and making  $l = 5$ ,  $\alpha =$  the same number, and  $t' = 12^\circ,56$ , the excess of  $18^\circ$  over  $T = 5^\circ,44$ . These methods both give  $L = 5,0001179$ , thus a base of 2000 times this rod =  $10002,358$ . If the rod was taken as five metres, regardless of expansion due to the metal, it is evident that the very considerable error of  $2,358$  would be committed in the measurement of this distance.

134. *The reduction of a broken base to a right line.*—It is desirable always that the base should be one unbroken right line; but it is not always that ground can be found running in a direct line, and nearly horizontal, for a distance of some 10,000 metres. We are then obliged to measure the length indirectly. This was the case in the measurement of the bases of Melun and Perpignan.

Suppose  $A B C$  to represent the broken line, or base, and that we know the lengths  $A C$ ,  $C B$ , and the angle  $\theta = 180^\circ - C$ , which we

suppose to be nearly  $180^\circ$ .  $\theta = \angle B C$ , and making  $A C = b$ ,  $B C = a$ , it is required to find  $A B = c$ , which is to be regarded as the measured base. We have\*

$$c^2 = a^2 + b^2 + 2ab \cos. \theta$$

and by making  $\cos. \theta = 1 - \frac{1}{2} \theta^2$ , neglecting the fourth powers of  $\theta$  we have

$$c^2 = (a+b)^2 - ab \theta^2, \quad c = (a+b) \left[ 1 - \frac{ab \theta^2}{(a+b)^2} \right]^{\frac{1}{2}}$$

and by developing the power  $\frac{1}{2}$  as far as the terms of the second degree, and designating by  $\theta$  the number of minutes in this arc, we have

$$c = a+b - \frac{ab \theta^2 \sin.^2 1'}{2(a+b)}.$$

When the signal at B cannot be seen from A, and the signal C can be, it is necessary to know the angle A, as the neighbouring points which are measured in relation to A C should be referred to the base A B.

We have  $\frac{\sin. A}{\sin. \theta} = \frac{a}{c}$ , and  $\sin. \theta = \theta - \frac{1}{6} \theta^3$

from which we get

$$\sin. A = \frac{a \theta}{c} (1 - \frac{1}{6} \theta^2)$$

and by substituting for  $c$  its value given above, we have

$$\sin. A = \frac{a \theta}{a+b} \left[ 1 + \frac{ab - a^2 - b^2}{6(a+b)^2} \theta^2 \right]$$

Now (see trigonometry,)  $\text{arc } A = \sin. A + \frac{1}{6} \sin.^3 A$ , and substituting for  $\sin. A$  its value, and then changing the small arcs A and  $\theta$  into A sin. 1' and  $\theta$  sin. 1' to express them in minutes, we have

$$A = \frac{a \theta}{a+b} + \frac{ab(a-b) \theta^3 \sin.^2 1'}{6(a+b)^3} \dots \dots (6)$$

135. *Reduction to the level of the sea.*—The difference between the elevation of the two extremities of the base are known by calculation, and if we suppose the base to be turned about its middle point until one end is depressed as much as the other is raised, the base may be regarded as an arc of a circle with slight curvature, having its centre at the centre of the earth. Suppose A A' is this arc = B, the length of which is known; and that  $a a'$  is the concentric arc described on the level of the sea:  $C a = K$  the terrestrial radius, or the normal

\* The triangle A B C is spherical, but is reduced to a right line triangle by subtracting from the observed angle C the third of the spherical excess, and taking the remainder for the value of C. In fact, a base is a line of double curvature, but we consider the earth as spherical, and the arc as being that of a circle contained in a vertical plane. The error from this supposition is inappreciable.

to the surface,  $\Lambda a = h$  the height of the extremities of the base above the level of the sea.

It is required to find the arc  $a a' = b$ , which is the base B reduced to the level of the sea. The plexus of geodesic triangles is projected on the surface of this level, and it is therefore necessary to project the base upon it also. The length B is, in fact, measured upon the arc of a circle, because the horizontal direction, perpendicular to the normal, is constantly preserved either by mechanical means or by calculation. The manner of obtaining the height  $\Lambda a = h$  will soon be shown; it is the elevation of the middle point of the base above the sea.

We have the proportion  $C A : C a : A A' : a a' = b$

$$b = \frac{B R}{R + h} = B \left( 1 - \frac{h}{R^2} + \frac{h^2}{R^2} - \&c. \dots \right);$$

as R exceeds six millions of metres, (nearly seven millions of yards,) and as  $h$  is always very small the series is converging, and we can, in almost every case, take the two first terms  $B - \frac{Bh}{R}$ . Thus to reduce

the base to the level of the sea it is necessary to subtract  $\frac{Bh}{R}$ .

136. We have now given an account of the operations and calculations necessary to obtain a geodesic base. It is the most delicate of all geodesic operations, as the accuracy of all other results depends upon it. The utmost care is therefore necessary in all the details of its measurement. To give an example of the great accuracy it is possible to attain, we will instance the measurement of the bases of Melun and Perpignan, measured by Delambre and Méchain, the first near the road from Paris to Melun, and the other from Vernet to Salces.

The base of Melun, after the corrections were made, and it was reduced to the level of the sea, was found to be 6075,90 toises; and that of Perpignan 6006,249 toises.

The distance between these bases was considerable, and they were connected by a chain of sixty-three triangles of the first order. By the aid of formulas, which will be given hereafter, one of these bases was calculated from the other, and the result was as follows:

|                                  |                                 |
|----------------------------------|---------------------------------|
| Base of Perpignan, measured, was | 6006.249 (13135.6665 yds. Eng.) |
| “ “ calculated,                  | 6006.089                        |
| Difference,                      | 0.160                           |

Thus the error is only 0,16 of a toise, or 11.52 inches, (12.55 inches English,) a quantity scarcely worth noticing. This coincidence, however, is no doubt attributable to the compensation of errors, as the



chain of triangles from Orleans to Bourges was found defective in the verification it was subjected to when the chain for the *meridian* of Fontainebleau was measured. The error was confirmed by another lateral line to the west of the first.

These results, then, are not cited to show their exactness, but rather as examples of the care necessary to be taken.

Seven bases have been measured in France, and compared with each other, by connecting them with a chain of triangles. The results will be given hereafter. The errors are so small that they may be attributed to causes which will be assigned hereafter, rather than to the imperfection of the operations themselves. These magnificent works are in the highest degree honourable to the able engineers entrusted with their execution. For a comparison of the base measured on the Bordeaux Heaths, with that measured by Oriani, near the Tession, see the *Nouvelle Description Géométrique de la France*, p. 458.

TO BE CONTINUED.

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*Notes on Belgium.* By CAPTAIN G. W. HUGHES, *United States Topographical Engineer.* Addressed to FRANCIS MARKOE, JR., Esq., *Corresponding Secretary of the National Institution, Washington.*

[CONTINUED FROM PAGE 232.]

Our next visit was to Fontaine l'Eveque, about seven miles from Charleroi, up the Sambre, the seat of the nail factories of the Province of Hainault. There are about 5000 persons employed (during the winter,) in the fabrication of nails; but not more than forty of this number are connected with the machines, all the others being occupied in forging nails by hand. The machines used here are an American invention, and exact copies of Judge Pierson's, which may be seen in operation at the Ramapo works, New York.

It requires much better iron for cut than for wrought nails, and it is asserted that, as it regards the larger sized nails, the iron plates, adapted to the machine, cost more than the same weight of wrought nails. This will explain the reason why so many persons are engaged in the slow operation of forging them by hand. It must also be remembered that wages are extremely low, and that, of course, labour-saving machinery is less important in Belgium than in most other countries. An agricultural labourer receives only 1fr. 10 centimes a day, or about twenty cents of our money, and finds his own subsistence. When the severity of winter drives these people from the fields they engage in nail making, at probably no higher rates of wages.

The "Clouterie à la Mécanique," or manufactory of nails by machinery, also belongs to an anonymous company, under the patronage of a bank, and is in charge of a director, Mr. D'Haussey, by whom we were most kindly entertained. It consists of thirty machines, making as many different sized nails, put in motion by an engine of thirty horses power, which is competent to the working of sixty machines, the whole number of which the director calculates will be soon put in operation. Each machine makes 120 nails per minute, every revolution cutting and heading one nail. It requires no other attendance than simply *feeding* it with iron, which it seems to *eat* with as much avidity and gout as an anaconda exhibits in gorging its prey. There is, however, another American nail machine, far superior to the one now in use, which makes a better nail, and cuts, it is said, from 600 to 1000 per minute. It is called "Hunt's Patent," after the inventor, an ingenious mechanic of New York.

There are something more than 12,000 tons of nails fabricated annually in Belgium; of which about one-fourth part are exported.

The following extracts from the printed tariff of prices will show their sizes, prices, &c.

| No. of thousands to the ounce. | Price per thousand | Price per kilogramme. |        |
|--------------------------------|--------------------|-----------------------|--------|
|                                |                    | Dollars.              | Cents. |
| 3                              | 30 centimes.       | 3                     | 42     |
| 6                              | 34 "               | 1                     | 93     |
| 12                             | 42 "               | 1                     | 19     |
| 16                             | 48 "               | 1                     | 04     |
| 32                             | 71 "               | 0                     | 75     |
| 96                             |                    | 0                     | 56     |

The next day we turned our attention to the glass and chemical works at Oignies, about nine miles from Charleroi, on the road to Fleurus and Ligny. This establishment occupies the buildings and former site of Oignies, a Monastery of learned Augustine Monks, which was suppressed by the French revolutionary army, and the property confiscated to the state. Very extensive buildings have been added to the old monastery, and these works now cover an area of thirteen English acres. They belong to an anonymous society,

with a capital of 10,000,000 francs, under the patronage of the *Société générale de Belgique*.

Mr. Kemlin, the highly intelligent director, conducted us over these works, and was at much pains to show, and to explain to us, even the minutest details connected with this vast establishment.

The director led us first to the chemical department, which may be regarded as a grand laboratory, where operations are carried on, almost, on the scale of nature. Our attention was drawn to the formation of sulphuric acid in the large way. The first process is to procure the sulphur, which is obtained from iron pyrites, a material sufficiently abundant in most coal measures. This mineral, or *mundic*, as the British miners call sulphuret of iron, is washed, ground to powder, and dried. It is then put into furnaces, and the sulphur, expelled by heat, is conducted into large leaden chambers. During its transit it combines with oxygen, forming the sub-acid or sulphurous acid gas. To still further oxygenate it nitric acid is used. This is liberated from the nitrate of potash, and passed into the leaden chambers at the same time with the sulphurous acid, by which it is decomposed—the oxygen uniting with the sulphurous acid forming sulphuric acid, and the nitrogen escaping free.\* The sulphuric acid is then passed through several leaden chambers containing water, by which it is absorbed. 2,000,000 kilogrammes, or more than 4,000,000 lbs. of this acid are made here annually; and it sells for \$4 the French quintal, (of 100 kilogrammes,) which is the usual measure of sale, and is equal to 220½ lbs. English.

We next saw the manufactory of sulphate of soda. It is obtained from a substance called *marine salt*, (which term, I understood from the director, is applied to a mixture of the sulphates and muriates of soda, separated from the other salts contained in sea water.) This article is admitted free of duty, at the Custom House, but is *poisoned* to prevent its use for domestic purposes. This salt is placed in a furnace, and the muriatic acid is expelled in a gaseous form, and passed through a great number of large earthen retorts connected together with bent tubes of the same material. These retorts are partly filled with water, which absorbs the gaseous acid, forming hydrochloric acid. Of this there is made annually about 500,000 kilogrammes, or 1,100,000 lbs., which sells for about fifty cents the 100 lbs. A portion of it is passed over quick lime, forming the chloride of calcium.

The sub-carbonate of soda, so much employed in soap and glass making, is formed by taking a mixture of sulphate of soda, carbonate of lime and charcoal, and calcining them together in a furnace. During the calcination a double decomposition takes place, and the pro-

\* It is necessary to remind our readers that the theory of the formation of sulphuric acid is by no means so simple as is here supposed.—COM. PUB.



ducts are a mixture of sulphate of lime, (insoluble,) and sub-carbonate of soda, (soluble.) These substances are separated by the action of water, which takes up the soda and leaves the lime. This residuum is used as a manure. The solution is now boiled down, and the salt obtained in a crude form. It is then again dissolved, evaporated by boiling, and kiln dried, forming the ordinary sub-carbonate of soda of commerce. When it is desirable to obtain it of a very pure character it is once more dissolved, and then left in vats to crystalize, on strings placed in the fluid for the purpose.

A portion of this salt is sold, and the rest is employed in the glass works. The annual production is about 2,000,000 lbs., and it sells for \$6 50 cents the 110 lbs., or \$13 the French quintal.

There are 250 persons employed in this department; the men receive two and a half francs a day, and the women and boys from seventy-five centimes to one franc a day.

Our next visit was to the glass works—they are exclusively devoted to the fabrication of looking glasses and very large plate, window and door glass, of the better quality.

Glass is made from the fusion of a mixture of sub-carbonate of soda and sand. The sand is very nearly pure silex, as white as snow, and very fine. It is brought from the Ardennes, where it occurs in beds forty feet thick. It is worth from one and a half to two and a half francs the French quintal, or 220½ lbs. English. It is washed, to separate the earthy matter from it, and kiln dried.

The proportions of sub-carbonate of soda and clean sand, entering into the composition of glass, are variable, depending on the quality of the former. When it is very good, the mixture is *one part* soda and *three parts* sand—when inferior, it is mixed with equal quantities of sand. This mixture is melted in furnaces, somewhat resembling, in appearance, blast furnaces, but not so large. Coal is used as the fuel. In furnaces of the most approved form the mixture may be fused in fifteen hours, but in others it requires, for this operation, twenty-four hours. The broken fragments and clippings of glass are re-melted.

The melted glass is run into large argillaceous tubs, by which it is conveyed to an iron table, about twelve feet long and seven feet broad, on which it is poured; and while still soft, an iron roller, about one foot in diameter, is repeatedly passed over it. As soon as the plate becomes solid it is placed to cool slowly, in a low, flat, arched receptacle, which is closed up, and the plate is left here twenty-four hours. When taken out, it is scarcely translucent, and seems to be covered with large, slightly convex blisters, and its edges are uneven, and sometimes defective, for several inches in width.

The tub by which the melted matter is carried from the furnace to the table is called a *cuvette*, and is made from a dark blue clay, found near at hand. This clay is nearly pure alumine, and when baked by a slow fire, (after having been prepared for the purpose by washing, grinding, etc. etc.,) it is sufficiently hard to strike fire from steel.

The crude plate is now carried to the rough polishing house. In this house are eight large smoothly-polished marble slabs, each rather larger than the iron table, solidly laid in mortar, on brick foundations. These slabs are covered with a gypseous paste, and the glass plate, fastened to an iron frame moved by steam, is ground on the marble by a species of circularly rubbing motion. Presently it is fixed to the slab, and its upper surface is rubbed in a similar manner. It is then transferred to other slabs, where two slabs are ground together by machinery, with fine sand between them, and jets of water continually playing on them. Next they are ground, in the same way, with emery instead of sand, till their surfaces are nearly uniformly smooth. They are now carried to another house, where they are ground together by hand, with nothing between them, till they are perfectly smooth. They are then fixed on a table to be polished. The polishers are made of coarse felt, fastened to iron frames, moved by steam. The substance used for this purpose is a *crocus*, obtained from an ochrey red oxide of iron. After being rubbed on both surfaces till it is supposed the plates are perfectly polished, they are removed to the finishing room, where they are carefully rubbed by hand, for the last time, with *crocus*.

The next operation is the cutting of the glass to the required dimensions, (for it is always cast large.) This is done with a diamond, and a single line, seeming scarcely to penetrate the surface, is sufficient even for the thickest glass. A slight, quick blow, from below, completely separates the parts, leaving the edges perfectly smooth.

The finishing process for mirrors consists in the application of the amalgam. As much mercury is poured on the table as the tin leaf can be made to take up, and the glass is then forced over the amalgam, beginning with one edge, and removes before it the surplus mercury. This requires some care and skill, especially with a large glass. The director is making arrangements to cast a plate (for a mirror, to be exposed at the coming "exhibition of industry," at Brussels,) the size of the iron table recently cast for that purpose at Couillet. The price of this large mirror will be, according to the tariff, some \$ 2,500. The largest which has, as yet, been sold at these works brought 9,835 francs. It was 150 inches  $\times$  100 inches. It would require eight days to finish one of these very large glasses if they should work on it uninterruptedly for that period. .

One hundred and fifty persons are employed in this branch of the establishment, and arrangements are being made to enlarge the buildings, and increase the number of employees, as a ready sale is found for all the glass they can make. The only difficulty is to secure the services of skilful workmen; who can earn from five to seven francs a day, (very high wages,) according to their knowledge and industry.

The Sambre passes directly under the walls of Oignies, and affords a convenient communication with Charleroi and Namur. It is called "*une riviere canalisé*," or a *canal-ized* river, which expresses the meaning much better than our term "slack water navigation;" and might be adopted into our language with some advantage.

In company with Mr. Meeas we visited a manufactory of sugar, from the beet root, belonging to a company called the *Raffinerie Nationale*, of which he is the president. The estate of this association consists of three large farms of 1,800 acres of rich land, and is devoted, primarily, to the cultivation of the sugar beet, but the corn is also grown, in order to preserve a certain alternation of crops. In connection with this main object they raise large numbers of stock, which are fed on the pulp after the saccharine matter has been expressed, and this yields no small amount of their dividends. The farms are kept in admirable order, and the buildings are very extensive, well arranged, and well built. Order and good management seem to reign everywhere under the admirable administration of its enterprising president.

The capital of the company is 4,000,000 of francs paid in, together with the application of the dividend, for the last two years, to the improvement of the works.

The annual production of sugar and gin is sold for about 200,000 francs. The wholesale price of sugar is eighty francs the French quintal, (of 100 kilogrammes,) and of gin, fifty-six centimes the litre, (about three pints English.)

The average crop, in good seasons, is about 14,000 kilogrammes, or fourteen tons English to the acre, which is worth sixteen francs the ton, or about \$44. The root, most in favour, is the Siberian, which requires a rich sandy loam, and a good deal of moisture, but the labour, per acre, is much less than that usually expended on the cultivation of tobacco.

It is said that the beet root possesses rather more saccharine principle than the same weight of cane; but thrifty housewives say that the sugar from it will not *go so far* for domestic use; and it is not so good for the preservation of *fruit*, as it causes the *sweet meats* to ferment.

The refinery is situated between Waterloo and Mont St. Jean, to



the left of the road to Quatre Bras. The buildings of this establishment cover some ten acres of ground, and are exceedingly well arranged. We were taken through every portion of it, and spent nearly the whole day in its examination; but as the subject is one that cannot be disposed of in the short limits of a paper, I shall not attempt the subject at present.

This estate extends to "the field of Waterloo;" and from the refinery we had a magnificent view of the lofty *lion monument*, which marks the spot where the Prince of Orange was wounded. In looking round on the soft landscape, the peaceful villages, and the fields rich with waving corn, I could not but recall to memory the beautiful and touching lines of Southey, so descriptive of the effect produced on my own mind in contrasting the fury of the battle with the air of repose which seems to pervade the locale of that bloody strife.

" Was it a soothing or a mournful thought,  
Amid this scene of slaughter as we stood,  
Where armies had with recent fury fought,  
To mark how gentle Nature still pursued  
Her quiet course, as if she took no care  
For what her noblest works had suffered there."

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On Cast Iron Rails for Railways. By ELLWOOD MORRIS, Civil Engineer.*

We are informed in Wood's treatise upon railroads, that in the early part of the seventeenth century, railroads were first used in England, and they were then formed of wood; the *wooden rails* were employed for about 100 years, when in 1767, *cast iron rails* were first introduced, and thereafter continued for a period of near fifty years, to be used instead of any other material; but in the year 1815 *malleable iron edge rails* were devised, and after Mr. Birkenshaw, in 1820, had obtained his patent for an improvement in the form of such rails, and applied the rolling mill to their manufacture, they were very extensively adopted, and subsequent to that period of time have been almost exclusively used; indeed, since the modern improvements in the means of intercommunication by railways have enabled locomotive steam engines to travel at velocities of thirty miles and more, per hour, the use of *cast iron rails* has been, for the present, laid aside, if not wholly abandoned, on public railways.

The chief reasons which seem to have induced engineers, both here and abroad, so much to prefer *malleable* before *cast iron rails*, as to exclude the latter from use, appear to have been, originally, a belief that,

1. Malleable iron rails were cheaper than those of cast iron.
2. Malleable iron rails being made in longer lengths caused fewer joints.
3. Malleable iron rails were less liable to fracture from concussion.
4. Malleable iron rails were thought to be somewhat more durable.

Although these reasons are very plausible they have nevertheless been found not to be valid in practice to the full extent that was anticipated by those who fostered them, and with regard to them it may be observed,

I. With respect to the comparative economy of cast and malleable iron rails, it is certain that the latter, in this country at least, are not cheaper than the former, and if made of American rolled iron instead of imported, they would be much more costly.

II. Convenience of handling seems to have fixed the length of wrought iron rails at about fifteen feet, and of this dimension there is but little difficulty either in moulding or casting rails; but it is very questionable whether sufficient practical advantages do not attend cast iron rails of six or ten feet length, to induce a preference to be given to them over others of greater lineal extent.

III. It is unquestionably true that *malleable iron rails* are far stronger than *cast iron* ones of the same dimensions, when exposed to a *direct impulsive force*; indeed, we find it stated in Tredgold's essay on the strength of metals, "that a velocity, (direct,) of  $17\frac{6}{10}$  feet per second, or twelve miles per hour, would break a beam (of cast iron;) or a beam would break by falling from a height of five feet!"

Now if any such force was actually brought to bear upon the rails of railways in practice, it would, of course, be improper to employ those of cast iron, but happily this is rarely, if ever the case, for although Tredgold's statement may be true, when a weight *falls directly* upon a cast iron beam; no such result would ensue from *oblique impact*, with the same momentum that would be generated in the supposed case; and as the concussions produced upon a railway by a train at speed are of the latter character, it becomes necessary to inquire what vertical stress, or pressure, imposed by the wheels, results from their *oblique impact* when in rapid motion upon the rails?

A little reflection will satisfy any one that the impact upon the rail of a carriage wheel running at high speed, is a very different affair from the concussion produced by a weight falling freely; for instance, if an engine with a velocity of thirty miles an hour passes over a rail which, at the joint, is  $\frac{1}{10}$  of an inch higher than its neighbour, the wheel would advance in the air without touching the rail for the space of *one foot*; for, by gravity, "a body requires  $\frac{1}{14}$  of a second to fall  $\frac{1}{10}$  of an inch, and in that space of time a wheel running at the

rate of thirty miles an hour would move horizontally forward *one foot;*" in such a case, then, the wheel may be regarded as having traversed in the air an inclined plane, of which the base would be 120 times the altitude, and consequently if the force of impact be resolved by the parallelogram of forces, into two others, one perpendicular to the rail, and the other parallel to it, the former will be not quite the  $\frac{1}{120}$ th part of the whole impulsive force, instead of being equal to it, as would have been the case if the stroke were direct, or if the engine had fallen freely by the action of gravity alone through the vertical space of  $\frac{1}{10}$ th of an inch, and the percussive force upon the rail, produced by a free fall through even that small height, would far surpass that which would be created by the  $\frac{1}{120}$ th part of the oblique momentum of the wheel at the pace of thirty miles an hour.

This reasoning leads us to the conclusion that in such cases the greater the velocity of the engine the less will be the vertical pressure of the wheel upon the rail, and this, to a certain extent, is undoubtedly true, for the horizontal component of the force of impact will be greater than the perpendicular one, just as the velocity is greater.

Upon the same principle it is, that a musket ball shot parallel along a horizontal plane, so as to barely touch it tangentially, will not press upon the plane at all within the limits of its level or point blank range.

Whether these views agree or not, with those commonly entertained concerning fast trains on railways, they are, nevertheless, legitimate deductions from the established doctrine of forces, and serve to account for the small effect produced by the ordinary inequalities of a railroad, as shown in the results displayed by the following direct experiments touching this matter, which were made by Professor Barlow, and recorded in his work on the "strength of materials," English edition, 1837; these experiments are conclusive in their character, and establish, beyond question, the fact, *that the vertical stress imposed upon a railway by the transit of locomotive engines at velocities varying from twenty-two to thirty-two miles an hour, is but little, if any, in excess of that produced by a quiescent load of the same weight!*

These experiments by Professor Barlow, were made with an ingenious and accurate instrument, to determine the deflection of rails under trains running at high speed, and as the deflection of materials under a strain, is as the insistent weight, the vertical pressure upon the rails is by this means accurately indicated.



Experiments.

|                                                                                                                                                     |     | Deflection in inches<br>of the rail in the<br>middle length. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------------------------------------|
| 1. Speedwell engine and train at twenty miles an hour,<br>weight upon the driving wheels nearly six tons, or three<br>tons on each wheel. - - - - - | = { | .0425<br>.0400<br>.0400<br>.0320                             |
| 2. Ditto same speed, - - - - -                                                                                                                      | = { | .0400<br>.0420<br>.0240                                      |
| 3. Ditto very slow, - - - - -                                                                                                                       | = { | .0250<br>.0320                                               |
|                                                                                                                                                     |     | 9 ).3175                                                     |

Mean deflection in these experiments, inclusive of the }  
yielding of the stone block supports, - = .0353

Now, by trials made with direct pressure, upon the same railway bars which were travelled over by the trains in the above experiments, and then taken up and forwarded to Woolwich, for the purpose of examination, Professor Barlow states that the mean deflection, under a load of three tons weight at rest, was - - - = .0314

Whilst the mean deflection, under trains in motion, at velocities as high as twenty miles per hour, as stated above, amounted to - - - = .0353

Difference, - = .0039

which, when we consider that a portion of this difference is due to the depression of the blocks, indicates "a close agreement, which shows, that when every thing is well fixed and secure, the deflexion, and consequently the strain, is nearly the same, whether the load be *in motion or at rest*; and that each rail is only pressed with half the weight on one pair of wheels."

The rail tried in the preceding experiments, was that of the Grand Junction Railway, weighing sixty-two pounds per yard, and laid with three feet nine inches bearing; in those following, Professor Barlow employed the same pattern of rail, but laid with bearings five feet asunder.

Experiments.

|                                                                                                           |     | Deflection in inches<br>of the rail in the<br>middle length. |
|-----------------------------------------------------------------------------------------------------------|-----|--------------------------------------------------------------|
| 1. Swiftsure engine, velocity twenty-two miles an hour,<br>three tons weight on each driving wheel, - - - | = { | .093<br>.077<br>.080                                         |

|                                                          |   |   |           |
|----------------------------------------------------------|---|---|-----------|
| 2. Ditto same speed,        -        -        -        - | = | { | .082      |
|                                                          |   | { | .070      |
|                                                          |   | { | .077      |
| 3. Speedwell engine, velocity thirty miles an hour,      | = | { | .112      |
|                                                          |   | { | .091      |
| 4.            Ditto, velocity thirty-two miles an hour,  | = | { | .122      |
|                                                          |   | { | .115      |
| 5. Fury train, velocity twenty-three miles an hour,      | = | { | .083      |
|                                                          |   | { | .085      |
|                                                          |   |   | <hr/>     |
|                                                          |   |   | 12 )1.087 |
|                                                          |   |   | <hr/>     |

Mean of these experiments, inclusive of the yielding of }  
the stone block supports,        -        -        -        } = .090

In experiments made at Woolwich, with vertical weights at rest, upon the same rails, the mean deflection produced at five feet bearing by a quiescent load of three tons, was        -        -        = .079

And the mean deflection found above, with three tons on a wheel in motion, at rates from twenty-two to thirty-two miles an hour,        -        -        = .090

Difference, part of which is owing to the depression of the blocks,        -        -        -        -        = .011

Upon the whole series of these experiments, Professor Barlow observes that "nothing can be expected much more satisfactory, as it is thus proved, *independently of any opinion*, that while the blocks and fixings are secure, the strain from a passing load is but little in excess of that from a quiescent load."

The above quotations, demonstrating as they do distinctly, that the vertical stress of trains at speed, surpasses so little the effect of quiescent loads of the same weight, (*that it is only necessary to proportion the rails of railroads to resist quiescent, and not concussive forces,*) change the whole face of the question between *cast and wrought iron rails*; they strike away all the objections heretofore urged against the brittleness of cast iron, for it does not admit of doubt, that a beam of that material, of suitable proportions, is quite as competent to carry a quiescent load as is one of malleable iron; again, a cast iron rail will yield sufficiently to impact, and return to its proper level the moment it is relieved of the weight of a train, for it is well known that its elasticity and power of restoration, after deflection, is within certain limits so perfect, that owing to its regularity in that respect it was even proposed by Tredgold to use beams of cast iron as weighing machines, measuring the weights imposed by the deflections produced!

In view of the conclusive arguments of Professor Barlow upon the relative effect of passing and quiescent loads upon railways, we may limit our researches to ascertaining simply the dimensions of a cast iron rail, *which shall have the same surplus strength to resist a quiescent load equal to the maximum weight upon one wheel, as is found in practice to be necessary in a malleable iron rail*; to aid us in this matter we shall again recur to the valuable work from which we have already quoted so much, and upon pages 428 and 430 these statements will be found; that when the road is in good order "the rail is only deflected at the greatest velocity, a little more than is due to a quiescent load, equal to half the weight on two wheels; but that in consequence of imperfections a strain is occasionally thrown on the rail which produces a deflection about double that which belongs to the load in question." And as a consequence of this, results the "experimental fact that with engines of twelve tons weight, (and three tons on a wheel,) running at velocities not exceeding thirty-two or thirty-five miles per hour, *it is not necessary*, even as railways have been hitherto constructed, to provide for a strain of more than seven tons, which is allowing a surplus strength of sixteen per cent. beyond the double of the mean strain," and this was experimentally found to be a strength amply sufficient to resist the lurching of locomotive engines running at high speed. Tredgold, on the strength of metals, informs us that compared with *cast iron as unity*, the strength of *malleable iron* is  $1\frac{12}{100}$  times, and its stiffness  $1\frac{3}{10}$  times.

Now as the stiffness of rails is a matter of such importance as to be almost the controlling desideratum upon railroads, having, in fact, induced the preference given to parallel over fish-bellied rails, it would, perhaps, be proper so to proportion cast iron rails that they may be *as stiff* as those of malleable iron of suitable strength; hence in the case of a railway destined to carry at a high speed locomotive engines of twelve tons weight, and running three tons upon a wheel, as assumed by Professor Barlow, if *a wrought iron rail* possessing an elastic strength of seven tons\* is sufficient, *a cast iron one* to have the same stiffness should be proportioned to resist a vertical weight of nine tons, for supposing the stiffness to be as the weights imposed, and the comparative flexibility of the two materials, we have

\* The necessity of proportioning rails to resist strains so much greater than is really produced upon a way in accurate adjustment, arises chiefly from an unequal settlement taking place in the two lines of rails, producing that lurching of carriages which sometimes doubles the weight upon a wheel; now, if in all cuttings, and upon all well consolidated embankments, both lines of rails were laid upon *a continuous bed of concrete*, of sufficient depth and width, it would be impossible for the rails to settle irregularly, and if they subsided at all, it would be so equally as to preserve still the proper relation to each other.



1 : 1.3 :: 7 : 9.1, which would give an excess of strength to the cast iron rail in the ratio of  $1\frac{3}{10}$  to  $1\frac{12}{100}$ .

Therefore it will be perfectly safe to assume, as the proper size for *cast iron rails*, sufficient dimensions to give them such a transverse section, as with the fixed length of bearing, will furnish a strength equal to *three times the maximum weight designed to be imposed upon any wheel*, and this is precisely the same conclusion as is arrived at by Mr. Wood, in his valuable treatise on railways, third edition, page 130.

The proportions proper for the section of a cast iron rail may be readily ascertained, either by the formula of Tredgold, which give an excess of strength, and the accuracy of which, up to the limit of perfect elasticity, has lately received ample confirmation;\* or the section may be more conveniently determined by the accurate rules given by Professor Barlow, for malleable iron rails, as quoted in the third edition of Wood on Railroads, allowing for the difference between the two materials in the ratio of 1 to  $1\frac{3}{10}$ .

If, notwithstanding all that has above been said concerning the capacity of cast iron rails to endure successfully the strains which really exist in railway practice, fears should still be entertained of their sudden fracture under trains at speed, all such fears may be completely nullified, by casting in the centre of the head, or top table of the rail, a rod of malleable iron of about a half an inch in diameter, as has already been done with success in cast iron wheels,† to prevent an immediate separation of the fragments in case of sudden breakage; and in addition to subserving its purpose effectually, the wrought iron rod would improve the chill of the head of the cast iron rail to an adamant hardness.

These observations apply especially to rails supported at intervals only, as is now the usual practice; but if the plan of *continuous bearings*‡ should be generally adopted in railways, the propriety of which has been strongly urged by English engineers, (see an able paper by J. Reynolds, Esq., Civil Engineer, recorded in the second volume Trans. Inst. Civ. Eng.,) as a perfect remedy for acknowledged defects, and which method has been used with success by Mr. Brunel upon the Great Western Railway; *all objections against cast iron rails must wholly vanish*; and with regard to railways of continuous bear-

\* See experiments on the strength of cast iron, by Francis Bramah, Civil Engineer, in the second volume Trans. Inst. Civ. Eng.

† At the works of the New Castle, (Del.) Manufacturing Company, and also at other places; by this operation the strength of wheels is very materially augmented.

‡ The tendency of the extensive practice which has now been had on railways is certainly establishing gradually in the minds of engineers a conviction of the superiority of roads of continuous bearing laid with the U, or bridge rail, over those of any other construction.

ing, if the preservative processes now applied to timber should fully answer their intended purpose, without too much expense, as now seems highly probable, it cannot be questioned, that if laid upon Heron's patent trellis plan, or in some other mode, which, with continuous bearing, furnishes also the requisite solidity of foundation, and strength of lateral tie, such roads will possess unquestionable advantages over those laid with isolated supports.

There is another very important fact developed by the judicious experiments of Professor Barlow, which demands the attention of engineers in all subsequent railways, (particularly if they are not of continuous bearing,) whether laid with cast, or malleable iron; and that is, that if rails are supported by isolated bearings at *uniform* distances asunder, *they deflect unequally between the supports when traversed by the trains*; the joint lengths are the most flexible, and consequently, in order that the railway may be equally stiff in every part, the rails must either be made of greater size in the joint bearings, or else the supports at the joint ends must be brought nearer together, in the same proportion as the deflection of the joint length beneath a passing train is greater.

Professor Barlow found by experiments made with his accurate deflectometer, that the heavy rails of the Grand Junction Railway, laid with uniform bearings, deflected under trains running at velocities as high as thirty-two miles an hour, .121 in the joint lengths, when in the middle lengths the deflection was only .090 of an inch.

Consequently, if the rails are of such length as to span *more than two spaces*, and if one of the middle bearings, or spaces, be assumed =  $x$ , then the joint bearing, if the rail has every where the same

transverse section, must be made =  $\sqrt[3]{\frac{.090}{.121} - x^3}$ , or  $\sqrt[3]{\frac{3}{4}x^3}$ , because

the deflection is as the cube of the bearing length; thus if the strength of a rail be calculated for bearings of three feet, and that distance be assumed for the central lengths between the supports, the joint lengths to make the rail equally stiff throughout must be

$$\sqrt[3]{27 \times \frac{.090}{.121}} = 2\frac{7}{10} \text{ feet.}^*$$

The principle that the deflections of rails of the same section are *as the cubes of their bearing lengths*, obtains, as a matter of course, in the case of trains at speed; thus in the experiments heretofore cited, the deflection of the Grand Junction rails, with three and three quarter feet bearing, was found by the deflectometer to be 0.353; consequently

\* The system of spacing the bearings unequally has been observed by those able Civil Engineers, Messrs. Knight and Latrobe, in planning the new track recently laid upon the Baltimore and Ohio Railroad.

the same rails, at five feet bearing, under trains of the same weight, ought to have deflected  $\frac{.0353 \times (5)^3}{(3\frac{1}{2})^3} = .084$ , the actual deflection found by experiment was .090 — a sufficiently near coincidence.

IV. On the subject of the comparative durability of wrought and cast iron rails, the experiments are not entirely decisive, but they certainly appear to incline in favour of those of malleable iron;\* although it must be remarked that the exfoliation and separation into laminæ, which, owing to the mode of manufacture, it was originally anticipated, would occur to wrought iron rails, when traveled by locomotives at high speed, and the existence of which was formerly most pointedly denied, *does actually take place*, as may be witnessed upon most of our railroads which have been long subjected to the action of heavy trains and high velocities; upon such we may perceive not only exfoliations on the rails, but also that in some instances the sides of the heads have been forced into laminæ, and almost, or actually crushed off; it cannot be doubted that all such disruptions of the material facilitate oxidation and wear, and, therefore, if due weight is given to this cause of deterioration, which was not formerly taken into the account of decay of wrought iron railways, there seems to be reason for the belief, that under the action of a weighty traffic, cast iron rails may reasonably be expected to endure quite as long, if not longer, than those of malleable iron, especially if the former have their heads, or top tables, properly *chill cast*, which ought certainly to be done; it must also be recollected that if from wear, breakage, or any other cause, it becomes necessary to substitute new rails, the old cast iron ones would be worth at the foundries, almost the price of pig metal.

#### General Remarks.

The introduction of the hot blast, by enabling the ores of iron to be smelted direct with raw bituminous coal, and the recent application of anthracite to the same purpose, rendered successful by the same means, has, in consequence of the diminished cost of cast iron in the coal basins, drawn the attention of enterprising practical men in this country, to the propriety of employing cast iron rails, instead of those made either of wood plated with wrought iron, or wholly of the latter material.

At the Lonaconing works in Alleghany county, Maryland, cast iron train rails, with an upright ledge, of the usual form, are wholly used for the service of the coal and iron mines.

The writer is indebted to J. H. Alexander, Esq., Civil Engineer.

\* See Wood on Railroads, third edition, page 133 and 729.



and Topographical Engineer of the State of Maryland, for the following information respecting the rails cast and used at those works.

1. The Lonaconing rails are of the common tram pattern, of three and a half inches base, and two and three quarter inches height; they are a little heavier at the joints than in the middle; the length of each rail is three and three quarters feet, the weight, forty-five pounds, or thirty-six pounds per yard lineal; for the curves, which are usually of ten feet radius within the mines, separate patterns are used in casting the rails.

2. Some of the rails were cast direct from the ore, and had the furnace continued in blast all would have been.

3. The hot blast was used in casting the greater part of the rails from the cupola, and altogether with those from the blast furnace.

4. There was no difficulty attending either moulding or casting the rails.

5. Intermediate between the ends which rested on a cross tie, there was placed out of doors a block of wood, but within the mines, slate was packed under the rails instead.

6. One hundred and ten tons of rails of the above pattern were laid.

7. These rails are valued at the furnace at \$40 per ton by the quantity.

8. The cars run upon these rails carried one ton, or one-quarter of a ton on each wheel, besides the weight of the car.

Mr. Alexander further observes, that from their experience at Lonaconing, he has "no doubt of the useful application of cast iron to larger works, and accordingly the plan of the railroad designed to connect the Lonaconing mines with the Potomac river, rests, in part, upon the adoption of that material."

Since iron has been made in Schuylkill county, in this State, by using anthracite as the fuel for reducing the ore, cast iron rails have been substituted in several coal railways instead of the plate rail upon wood; and wherever they have been used they appear to have fulfilled every expectation formed of their utility, and have been universally approved.

The writer is indebted to Samuel B. Fisher, Esq., of Pottsville, Surveyor, for the following information respecting the cast iron rails employed in that portion of the anthracite region of Pennsylvania.

1. The lengths of rails most used are six feet; but some of twelve and fifteen feet are about to be cast, and any required length short of twenty feet can be made.

2. Some of the rails have been run at the blast furnaces direct from the ore, whilst others were cast by the cupola.

3. The rails are generally laid on cross ties, three feet apart, from centre to centre.

4. Some rails have been cast by Eckert & Guilford, at Pinegrove, with charcoal fuel, of the weight of eighty-four pounds per lineal yard, from a pattern furnished by B. Ayerigg, Esq., Civil Engineer, the section being that of the U, or bridge rail, *cast solid*; the rails now cast at Pottsville are similar to the T pattern.

5. If care is taken in moulding and removing the castings no warping occurs.

6. The rails used under ground for mines, weigh from twenty-seven to thirty-two pounds per yard, whilst others, for outside use, weigh from fifty-three to sixty pounds per yard running.

7. Cast iron rails are found quite smooth enough for use.

8. The cast iron rails cost from \$40 to \$45 per ton at the blast furnace, and \$56 per ton when cast at the cupola from re-melted iron.

9. On the heavier rails, cars, weighing, with their loads, from four to four and a half tons, are drawn by horses at the rate of about four miles an hour.

10. Few, if any, instances have occurred of a rail breaking from regular use.

Mr. Fisher further states, that the rails cast at the foundries are preferred before those run at the blast furnaces.

On this branch of the subject, notwithstanding its importance in an economical point of view, there are no decisive experiments known to the writer, but this much we can declare, that it is by no means a settled point that castings made from re-melted iron are better than those which are run at the blast furnaces direct from the ore; at least, the idea of such superiority seems *to rest wholly upon opinion, and not upon experiment*; in the recent discussion which took place in New York, regarding the conduit pipes and other castings necessary for the supply of water to that city, it was stoutly maintained by the friends of the cupolas that castings from re-melted iron were the toughest and best, and this was as stoutly controverted by the advocates of castings run at the blast furnaces direct from the ore.

In the midst of the dispute, Frederick Graff, Esq., superintendent of the Water Works of Philadelphia, was appealed to, whose long experience in this matter entitles his opinion to the utmost respect, and he stated that the conduit pipes, and all the other castings, now, and for many years, used in the distribution of water through the city of Philadelphia, under a head as high as 100 feet, were made at the blast furnaces direct from the ore; Mr. Graff further declared, that after having, in 1821, repeatedly proved and examined pipes cast in

both ways, he had not been able, "with his experience, from that time to this, to determine why a pipe cast from the ore was not as good as one cast from re-melted iron, nor had he been able to determine why other castings cannot be made as perfect and durable from the ore as in any other manner."

On the other hand, the experiments detailed in Wood on Railways, third edition, page 127, show clearly enough, that a mixture of different kinds of cast iron forms a stronger, though also a heavier rail, than any one kind of iron cast separately; and this mixture can evidently be had only by re-melting iron through the agency of a cupola furnace.

But let this be as it may, there is no doubt that rails of sufficient strength can be most economically cast direct from the ore, and they would be cheaper than those produced at the foundries, even if it should be found necessary slightly to enlarge their dimensions.

The writer has been informed by Erskine Hazard, Esq., one of the managers, and Josiah White, Esq., the president, that the Lehigh Coal and Navigation Company having adopted a heavy T rail of malleable iron, for their railroad from Whitehaven, upon the Lehigh, to Wilkesbarre, upon the Susquehanna, a distance of twenty miles; contracted for it in England, at £10 10s. per ton; but one ship-load having been lost at sea, they resolved to supply its place with rails cast from anthracite iron, at the furnace now in operation upon Crane's principle, on the Lehigh Canal, about fifty-five miles below Whitehaven, the eastern terminus of the railroad; and with these they purpose laying about four miles of the road next to Wilkesbarre, on which horses are to be used.

The malleable iron T rail of the road referred to, weighs forty-eight pounds per lineal yard, and is near five inches deep, three quarters of an inch thick in the stem, and two inches wide on the head; the cast iron rail designed to supply its place upon four miles of the road, is of a similar section, but made six inches deep, a little larger every way, and weighs seventy-five pounds to the yard; it is cast in six feet lengths, direct from the ore, by anthracite worked with the hot blast.

The strength of this rail was tested at the furnace, with six feet bearing, and it required *more than* five tons weight to fracture it; consequently, at three feet bearing, its strength (with the same section being inversely as the distance between the supports,) is ten tons, but we have already shown, in a former part of this paper, that, according to Professor Barlow's experiments, and the relative properties of cast and malleable iron, an available strength of nine tons in a cast iron rail is ample to sustain the progress of trains carrying three tons on a wheel, and running at thirty miles an hour; consequently, if the



rail of the Lehigh and Susquehanna road is laid with three feet bearings, as is now contemplated, it will be equal to all the present exigencies of trade, and might be safely traveled by twelve ton locomotives at a very high speed; this rail covering *but two bearing spaces* between the joints, ought to have its supports spaced equally, which is, in fact, designed.

The writer has recently observed upon the Columbia railroad, a short distance laid with cast iron rails, apparently for trial; these are in section nearly parallelograms, about two inches thick by five inches deep; they are wedged in cross ties, about three feet apart, and appear to answer perfectly.

In a former part of this paper, we showed that a cast iron rail, of strength sufficient to resist, without permanent injury, a strain of nine tons, was equivalent in stiffness to a wrought iron rail of seven tons strength, and this ratio we took as the guide of comparison between rails of these materials; hence assuming that the weights of rails suitable for the same railway should be as these numbers, then if a wrought iron rail of seventy pounds per lineal yard is competent to carry any given trade, a cast iron one, proportioned for the same traffic, should weigh ninety pounds per yard, for 7 : 9 :: 70 : 90.

The cost of the *imported wrought iron rails* of the Lehigh and Susquehanna railroad, when delivered on the road, will be about \$ 65 per ton, whilst those of *cast iron*, for the same road, will scarcely exceed \$ 45; therefore, if the latter was strictly proportioned in strength to the former, the ratio of economy at the above rates would be,

|                   |   |   |   |   |            |
|-------------------|---|---|---|---|------------|
| 70 tons at \$ 65, | - | - | - | - | = \$ 4,550 |
| 90 tons at \$ 45, | - | - | - | - | = \$ 4,050 |

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Difference, - = \$ 500

which, with these particular prices, would make the cast iron rails cheaper than those of English rolled iron, in the ratio of nine to eight; and if compared with American wrought iron rails, the relative economy would be still more conspicuous; the price of foreign railway iron delivered in America, fluctuates very much, but it is believed that it would very seldom be so low as to make the rolled rails cheaper than those of cast iron of equal strength, even if the former should continue to be admitted into our ports free of duty. We do not wish to be understood as asserting, in this paper, that cast iron rails are intrinsically superior to those of malleable iron; all that has been proposed is to show that the former material is equally sufficient and suitable for the formation of railways, whilst it is generally *more economical*; but there is one practical advantage which is inherent to cast iron, and ought not to be overlooked, it is, *that it expands and contracts*

less than wrought iron by alterations of temperature. Tredgold's essay on cast iron, informs us that whilst malleable iron expands  $\frac{1}{143000}$  of its length by each degree of heat, cast iron elongates but  $\frac{1}{162000}$  by an elevation of temperature to the same extent, consequently their ratio of comparative dilatation is nearly as seven to eight.

That cast iron is thus refractory under heat, is of some practical importance, for if the rails be cast in lengths of ten feet, the lineal elongation produced by an alteration of  $100^{\circ}$  in the temperature, would be only  $\frac{1}{1620}$ , or about  $\frac{1}{14}$  of an inch, so that if rails of from six to ten feet lengths are used, and the laying is carried on at medium temperatures of the weather, they may then be placed almost, or quite in contact end to end, the unavoidable imperfections of the joints allowing sufficient play; and as the joints will therefore be so much closer than can be admitted with malleable iron rails, less objection will be made, even if their number should be greater.

James Herron, Esq., Civil Engineer, in a memoir descriptive of his patent Trellis railway, of continuous bearing,\* which he has recently laid before the public, makes, at page 35, the following judicious remarks, touching the subject we have under discussion, and which we take the liberty of quoting:

"That cast iron rails can be furnished from our own mines at a much cheaper rate in the United States, than foreign rolled iron rails, seems probable from the improved modes of smelting iron with anthracite coal. That they will fully answer the purpose, when constructed and laid as I have described, there are but few engineers of practical experience in mechanics, and who are familiar with the extensive use made of cast iron edge rails throughout England and Wales, on their mineral railways, will deny. Should there be some, however, who are disposed to advance adverse views, it matters not from what motives, let me ask them why is it that the chilled cast iron wheels of our railroad cars should have so completely superseded the imported wrought-iron wheels, if it be not their *greater durability and cheapness* that recommended them?

"Within the last two years, some millions of dollars have been sent out of the country for the purchase of railway iron, which has been, for the most part, admitted duty free, and if we may form an opinion from the rapid deterioration by crushing, exfoliation, and splitting of the heavy rolled iron rails but recently laid *on some of our roads*,

\* A very ingenious railway of continuous bearing, has been devised by B. H. Latrobe, Esq., Civil Engineer, (see the March No. of this Journal, 1841,) consisting of a Z rail attached laterally to a continuous string piece; this peculiar arrangement is strikingly deserving of trial upon a working scale, and *on a bed of concrete*.

many millions more must continue to follow them, to furnish a supply for the renewals and repairs, so that it will form an insatiable drain on the currency of the country.

"A material that enters so largely into, and forms so costly a part of, our great public works, should not, therefore, be imported from a foreign country, if we can by any possible device render our native materials available. That the large sums of money which would thus be retained in the country would greatly benefit the mining, manufacturing, and farming interests, and, in fact, all others, even the works themselves, by an increase of business, must be evident to all."

Reflecting, then, upon the following facts, that for a long series of years cast iron rails were successfully used in England for public railways, that they are now used a great deal in the mineral districts, that they were originally superseded, in consequence, chiefly, of the superior economy of malleable iron rails, that so far as they have been used in this country they have fully answered every expectation, that the peculiar character of the strains upon a railway is such as cast iron is well calculated to withstand, that they can be well and cheaply made in this country, instead of sending our money abroad for foreign iron, that the transportation of iron rails from the sea-board to many of the interior railways, is very expensive, and finally, that they are as cheap, or cheaper, than wrought iron rails of equal strength\*—can there be any reason why cast iron rails should not be universally adopted in the United States? On the contrary, are we not urged to their exclusive use by every consideration of economy, as well as of patriotism in supporting home, instead of foreign manufactures? And do not the arguments in favour of *cast iron rails*, appeal with peculiar force to all those states, which, like Pennsylvania, possess within their bosoms inexhaustible supplies, both of the ores of iron and the means of fusing them into metal?

*Philadelphia, September 1st, 1841.*

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*Remarks on the Bear Valley Coal District, in Dauphin county, Pennsylvania. By WALTER R. JOHNSON, A. M., Civil and Mining Engineer, Professor of Chemistry and Natural Philosophy, in the Medical Department of Pennsylvania College, Philadelphia. Late Professor of Mechanics and Natural Philosophy, in the Franklin Institute.*

This coal district embraces a very large amount of valuable coal land, and is one of the most accessible and most easily wrought, of all our Pennsylvania coal deposits.

\* The Congress of the United States, at their late session, have passed a law providing that from and after the 3rd of March, 1843, all foreign railroad iron imported into this country,



It lies between Lykens' Valley on the north, and Williams' Valley on the south; these two valleys being bounded, the former, on the north by Mohantango Mountain, and the latter, on the south, by Berry's Mountain.

These are termed red shale valleys, and are rich, productive, and extensively cultivated, yielding abundant supplies of agricultural produce suitable for a large mining district.

The coal formation proper is included in an elongated basin, or trough, called Bear Valley, situated between two elevated ridges, viz: Thick Ridge, on the north, dividing it from Lykens' Valley, and Big Lick Ridge, on the south, which separates it from Williams' Valley.

The approach to this valley is through a deep cut, or gap, in the Big Lick Ridge, called Bear Gap, formed by a creek which comes out of the valley and joins the Wiconisco, by which its waters are conveyed to the Susquehanna river at Millersburg.

This gap extending quite through the southern brim of the trough, and dividing the various beds of which the coal measures are composed, has left the edges, or rather *ends* of the coal seams so exposed, as to be entered by horizontal drifts, or gangways, involving no necessity for artificial draining. The coal seams both east and west of the gap, dip northwardly in an angle of about forty-five degrees, and hence when the gangways have been driven to the proper extent, the workings commence in an ascending direction, and the coal is delivered to cars in the gangways over shutes formed on the floors of the beds themselves. On some of the beds the breadth of working, or breast of coal, will not be less than 600 or 800 feet. In others it will probably exceed 1000 feet. This facility of delivering the coal obviates the necessity of handling it after being detached from the solid bed. The mines which I examined were perfectly dry, and more comfortable, therefore, than almost any others which I have visited in the anthracite coal fields.

But besides the facility of mining the coal on the southern side of the trough by means of the exposure of the ends of beds at the gap, there is the additional advantage of approaching the northern or south-dipping beds by means of a tunnel to be carried horizontally across the beds northwards, and through all the interposed strata of slates, sandstones, iron ores, fire clays, &c., and as each successive bed is reached, working right and left by drifts in a manner perfectly analogous to that which is now pursued at the gap.

The openings on these south-dipping beds, on the property of the Lykens' Valley Coal Company, at different heights on the slope of the ridge, have disclosed the fact that in numerous beds good coal is found even at a very few feet from the surface, with roofs and floors

shall be subject to "a duty of twenty per cent. ad valorem," and that no iron shall, hereafter, be allowed to enter duty free, except what may be required for railroads, or inclined planes, *now under construction*. This act would seem to settle the question of economy decidedly in favour of the use of cast iron rails, on all future railroads constructed by the American people.

of adequate consistence to allow of mining to within a few yards of the outcrop.

If all the beds of the formation, known to be eighty feet in aggregate thickness, lay in a horizontal position, a single acre of land in which they were so situated would contain 129,066 cubic yards, or the same number of tons of coal; and if the same thickness of coal in a single bed, or succession of beds, were inclined at an angle of forty-five degrees, the quantity of coal in an acre would be increased in the proportion of 142 to 100, or it would then be 183,273 tons. All the beds of an inclined formation may be worked on a single acre of land, supposed to extend in a very narrow strip quite across the breadth of the trough, and the whole number of acres may therefore be considered as possessing like advantages over the same number of acres, of which the strata should be supposed horizontal. Now 370 acres of the above company's lands lie in a broad belt stretching directly across the coal measures, and embrace as well those parts of the beds which lie below water level, as those which in the two mountain ridges rise up several hundred feet above that level. In these 370 acres there would be found, by the preceding computation,  $183273 \times 370 = 56,268,010$  tons of coal. Admitting that from denudation and other causes, only one-tenth as much coal shall ever be obtained, the yield of this small portion of the lands will be 5,626,801 tons, or such an amount that if 50,000 tons per annum were taken out, a century would be far from exhausting this limited part of the company's domain.

The present workings have hardly passed the threshold of the formation—and are in the thinner and less valuable beds, as all observation and experience tend to demonstrate. Even on the "Gap tract," so called, many of the more important beds of the formation remain yet to be explored.

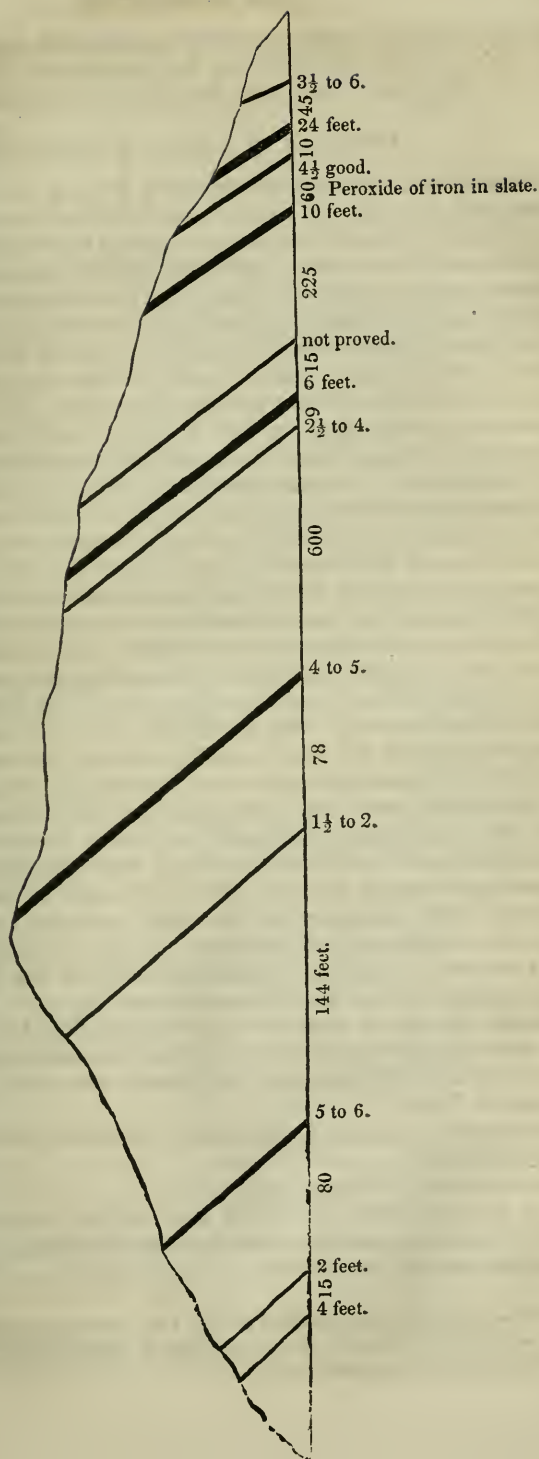
The following sketch exhibits the inclination, thickness, and distance apart of the beds in Thick Ridge, as observed and carefully measured at Rausch Gap, and confirmed by numerous openings opposite to Bear Gap. For this sketch I am indebted to Mr. P. W. Schaeffer, who prepared it from actual measurements. The dip is south eight or ten degrees east, about forty degrees.

From this sketch it appears that the total thickness of coal in the formation is not less than eighty feet on the north side of the trough, (and the same will doubtless apply to the south ridge,) and that more than two thirds of this thickness is found in seven beds lying in the inner, or *upper*, portion of the formation, and within a space of 130 yards measured horizontally across the strata. The openings at Bear Gap demonstrate the same general feature. Hence it is confidently believed that in a distance of two hundred yards, at most, all these beds will be reached by the tunnel above proposed, if commenced in the most favourable situation.

The tunnel might be twelve feet wide and seven high, and its execution might be progressive as new beds were required to be opened. The cost of excavation could not, I judge, in the materials here found, exceed ten dollars per lineal foot, for the first 200 yards.

*Section in Thick Mountain, East side of Rausch Gap.*

P. W. SHAEFFER.





In the beds to be reached by this tunnel, coal could be mined for fifty cents per ton, agreeably to the estimate of Mr. Schaeffer, who has been long conversant with the operations in this coal field.

### *Character of Lykens' Valley Coal.*

This coal is of the variety generally known in commerce as free burning red ash coal. It enjoys already a high reputation for giving, when used for domestic purposes, a steady but lively heat, and yielding little earthy residuum. It is also highly esteemed by smiths and founders; and not less so by those who have applied it to the production of steam, the burning of lime, and the smelting of iron.

The exterior characters of the coal of different beds are somewhat various; and it is not a little remarkable that the kind most sought after by blacksmiths, is that which, at first sight, might seem the most unpromising, being often covered almost entirely with a coat of yellowish or red oxide of iron, from which it has received the name of the "rusty vein." In other beds the coal is of the clearest jet black, and presents the varieties of tint, dull and bright, due to a greater or less intermixture of mineral charcoal with the pure anthracite.

The following analyses of this coal, with the subsequent comparison between it and the Welsh anthracite used by Mr. Crane, may be interesting in view of its applicability to iron manufactures.

The anthracite of Bear Valley is marked with numerous impressions of the vegetable substances from which the coal has been derived. These are not confined to the slates, but penetrate the body of the anthracite itself. The fossils are precisely similar in kind to those found in this and other countries, among the beds of bituminous coal, and correspond perfectly with descriptions already extant; and the minutest characteristic line traced on a bituminous coal slate in Great Britain, France, Germany, or South America, has its exact counterpart in the anthracite fields of Pennsylvania. Indeed there can no longer exist a question about the fossils of anthracite and bituminous coals belonging to the same geological period, since we know, that in one and the same coal trough we have perfect anthracite at one end, and perfect bituminous coal at the other, with a regular gradation of qualities between them.\*

Among the many varieties of anthracite found in Pennsylvania, none, according to my observation, bears a stronger analogy to that of Yniscedwyn in Wales, used at Crane's iron works, than the coal of Lykens' Valley.

The first step in tracing this analogy is to mark the relation by external characters.

These, in the Welsh coal, are,

1. A structure often lamellated, and tending to separate at the surfaces of deposition, owing to the quantity of carbonaceous clod which constitutes the dull seams between the bright plies of coal.

\* The fossils most frequently observed at Bear Valley are various species of *Filicites Stigmariæ*, *Lepidodendra*, *Calamites*, &c. A specimen of *Stigmaria ficoides* four inches broad, was found imbedded in pure anthracite.

*Tabular view of the Analyses of nine samples of Anthracite from the mines of the Lykens' Valley Coal Company.*

| No. of the sample. | Specific gravity. | Water expelled at 320°. | Volatile matter lost at redness. | Fixed carbon. | Earthy residue. | Exterior and other characters of coal.                                                                                                                                                                                              | Character of ashes.                                                                                              |
|--------------------|-------------------|-------------------------|----------------------------------|---------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| 1                  | 1.391             | 1.460                   | 6.140                            | 87.950        | 4.450           | Deep black—fracture irregular, shining—or dull from intermixture of charcoal—of which the structure is distinctly seen—and which is soft, sectile, and easily combustible—gives out gas, but does not change form on being ignited. | Colour deep brown—inclining to reddish brown—light—little coherent, moderately gritty.                           |
| 2                  | 1.404             | 1.390                   | 4.56                             | 89.300        | 4.750           | Brownish black—iridescent or steel blue—surface shining and striated—woody structure of the mineral charcoal seen as above—gas burns brightly.                                                                                      | Light fawn colour, moderately gritty—light—slightly coherent.                                                    |
| 3                  | 1.416             | 0.70                    | 9.30                             | 85.700        | 4.300           | Lustre silky on a carbonaceous ground—mixture of mineral charcoal in certain parts, with a coke-like mass.                                                                                                                          | Brownish buff—slightly coherent.                                                                                 |
| 4                  | 1.374             | 1.10                    | 3.50                             | 88.700        | 6.700           | Very similar to the preceding.                                                                                                                                                                                                      | Brownish—dirty red, with slight tinge of purple—very slightly coherent—incineration probably not quite complete. |
| 5                  | 1.376             | 0.88                    | 7.47                             | 87.750        | 3.900           | Colour deep black—fracture uneven with appearances of coke or charcoal.                                                                                                                                                             | Yellowish red—inclining to brown—dense—coherent.                                                                 |
| 6                  | 1.395             | 0.90                    | 7.40                             | 88.650        | 3.050           | This sample is less marked with carbonaceous deposits than the preceding—a purplish red tint marks some of the partings, or cross cleats.                                                                                           | Colour deep fawn, gritty—heavy, coherent.                                                                        |
| 7                  | 1.382             | 0.090                   | 7.75                             | 87.200        | 4.150           | Colour deep black—surface shining, striated, silky, and occasionally of a dull charcoal lustre—fracture uneven, original grain apparently obliterated by pressure.                                                                  | Bright fawn—with slight tinge of rose colour, gritty, coherent.                                                  |
| 8                  | 1.398             | 1.314                   | 10.54                            | 83.996        | 4.150           | Appears to resemble certain varieties of bituminous coal in structure, fracture and lustre, with slight specks of pyrites.                                                                                                          | Bright buff colour, tolerably coherent—slightly gritty.                                                          |
| 9                  | 1.378             | 1.360                   | 5.94                             | 87.000        | 5.700           | Dull black—surface shining at the fractures which cross the grain of the coal—horizontal seams conspicuous, fine carbonaceous dust seen in the interstices.                                                                         | Incineration not quite perfect, minute particles of coal perceptible—colour deep fawn.                           |
| m'an               | 1.390             | 1.111                   | 6.955                            | 87.360        | 4.572           |                                                                                                                                                                                                                                     |                                                                                                                  |

2. The abundance and magnitude of reeds and stems constituting the charcoal deposits, traversing the anthracite.

3. The shining and polished surfaces occasionally presenting themselves to view at some of the natural partings.

4. The purplish tints of metallic oxide often observable on the surfaces of fracture.

5. The general colour is deep black, and either dull, or shining, according as the ply which is examined belongs to the anthracite itself or to the carbonaceous clod partings of the seams.

By observing attentively the external characters described in the seventh column of the preceding table, it will be seen that all the foregoing distinctive marks belong also to the anthracite of the Bear Valley coal field.

The next circumstance worthy of attention in tracing the relation of coals, is their specific gravities. In the Welsh anthracite this is from 1.336 to 1.372, not much greater than that of many bituminous coals. The nine samples of the table above given afford a mean specific gravity of 1.390; the highest being 1.416, and the lowest 1.374.

The quantity of *volatile matter* next deserves notice. Of this, the Welsh anthracite contains by the mean of *two* trials made by myself, - - - - - 9.18 per cent.

of *two* by Mr. Mushet, - - - - - 7.23 “

of *one* by Mr. Frazer, - - - - - 7.60 “

The mean of these *five* is - - - - - 8.072

The water and *other volatile matter* in my analyses of Lykens' Valley coal are separately determined; the mean of water is 1.111, and of other gases, 6.955; the sum of which is 8.066.

The mean quantity of earthy matter in the Welsh anthracite by three of Mr. Mushet's trials is - - - - - 3.578

by one of Mr. Frazer's - - - - - 5.080

and the average of these two is - - - - - 4.329

In the Lykens' Valley anthracite, the table shows a mean of 4.572.

The quantity of carbon in the coal of Yniscedwyn as deduced from the preceding data is 87.599, while the table shows 87.360 in that of Lykens' Valley.

Bringing the preceding statements into a single view, the analogy will be perceived at a glance.

|                    | Sp. Gr. | Vol. Mat. | Carbon. | Ashes. |
|--------------------|---------|-----------|---------|--------|
| Yniscedwyn coal,   | 1.354   | 8.072     | 87.599  | 4.329  |
| Lykens' Valley do. | 1.390   | 8.066     | 87.360  | 4.572  |

If any thing more were wanting to make out the absolute identity of character in these coals, so remote from each other in locality, it would be supplied by the perfect similarity of effects observed to result from their distillation, yielding at first a gas burning with a pale blue flame, and afterwards, as the temperature rises, one of strong illuminating power, accompanied by a minute portion of bituminous, condensable matter. The illuminating gas seems to commence sud-



denly its development from the Welsh coal, and perhaps also from that of Lykens' Valley, but in the latter this circumstance was not particularly noted.

Rich and valuable as are the beds of anthracite in Bear Valley, it will be seen from what follows that these are not the only minerals worthy of consideration, embraced within the district. Like all other known coal formations, it is interspersed with seams of argillaceous carbonate of iron, but as no researches have yet been expressly directed to this object, but little more than the outcrop has hitherto been explored.

### Iron Ores.

The following analyses of the iron ores found in contiguity with the coal beds of Bear Gap, were made in the dry way, and may, consequently, be regarded as very nearly representing the results which would be obtained in the process of actual manufacture, except that as the ores were from near the outcrop of the bed they are rather richer in iron than they would have been, if not exposed to the influences of air and moisture.

No. 1. *Species*.—Argillaceous carbonate, passing into hydrated peroxide of iron.

*Description*.—Form spheroidal; texture, coarse; colour, from grayish blue to reddish brown.

|                                        |       |   |                |
|----------------------------------------|-------|---|----------------|
| <i>Specific gravity</i> , at 62° Fahr. | 3.40. |   |                |
| Water expelled at 350°                 | -     | - | 2.82 per cent. |
| Loss by calcination,                   | -     | - | 20.87 "        |
| Pig metal obtained,                    | -     | - | 42.37 "        |
| Earthy matter,                         | -     | - | 21.84 "        |
| Oxygen,                                | -     | - | 12.10 "        |
| <hr/>                                  |       |   |                |
| 100.00                                 |       |   |                |

The pig metal obtained in this assay was moderately hard, amorphous, or granular in structure; of a mottled grey colour. The cinder was ash-coloured and opaque.

No. 2. *Species*.—Hydrated peroxide of iron—argillaceous.

*Description*.—Colour, reddish brown; fracture irregular—sectile—soils strongly.

|                                     |        |   |                |
|-------------------------------------|--------|---|----------------|
| <i>Specific gravity</i> , at 64°    | 3.347. |   |                |
| Water expelled at 320°              | -      | - | 0.89 per cent. |
| Loss by calcination, chiefly water, | -      | - | 10.51 "        |
| Yield in pig metal,                 | -      | - | 51.35 "        |
| Oxygen,                             | -      | - | 22.00 "        |
| Earthy matter,                      | -      | - | 15.25 "        |
| <hr/>                               |        |   |                |
| 100.00                              |        |   |                |

Pig metal moderately hard; structure, fine granular; colour, lively grey.

Cinder—a purplish, semi-transparent glass.

No. 3. *Species*.—Nearly the same as the preceding, and probably derived from the same bed.

|                                  |        |   |   |        |           |
|----------------------------------|--------|---|---|--------|-----------|
| <i>Specific gravity</i> , at 69° | 3.286. |   |   |        |           |
| Water lost at 320°               | -      | - | - | 1.00   | per cent. |
| Loss by calcination,             | -      | - | - | 10.13  | "         |
| Pig iron,                        | -      | - | - | 51.60  | "         |
| Oxygen and earthy impurities,    | -      | - | - | 37.27  | "         |
| <hr/>                            |        |   |   |        |           |
|                                  |        |   |   | 100.00 |           |

Pig metal lively grey, moderately hard, and rather brittle, compact; fracture smooth.

Cinder—a purplish, smoky glass.

No. 4. *Species*.—Argillaceous carbonate of iron, nearly hydrated or transformed into hydrated peroxide of iron.

*Description*.—Colour, bluish grey; structure, coarse, hard; fracture, uneven, splintery.

|                                  |        |   |   |        |  |
|----------------------------------|--------|---|---|--------|--|
| <i>Specific gravity</i> , at 61° | 3.463. |   |   |        |  |
| Water lost at 320°               | -      | - | - | 14.95  |  |
| Loss by calcination,             | -      | - | - | 9.92   |  |
| Pig iron,                        | -      | - | - | 51.80  |  |
| Earthy matter and oxygen,        | -      | - | - | 25.33  |  |
| <hr/>                            |        |   |   |        |  |
|                                  |        |   |   | 100.00 |  |

The pig metal is compact, but soft; dark mottled; lighter portions ranged in minute pentagonal figures. Cinder, a black glass.

No. 5.—Characters similar to the preceding.

A portion of the exterior shell is sectile; interior, hard.

|                                  |        |   |   |        |  |
|----------------------------------|--------|---|---|--------|--|
| <i>Specific gravity</i> , at 61° | 3.480. |   |   |        |  |
| Water lost at 320°               | -      | - | - | 1.69   |  |
| Loss by calcination,             | -      | - | - | 10.83  |  |
| Pig metal obtained,              | -      | - | - | 54.15  |  |
| Earthy matter,                   | -      | - | - | 13.66  |  |
| Oxygen,                          | -      | - | - | 19.63  |  |
| <hr/>                            |        |   |   |        |  |
|                                  |        |   |   | 100.00 |  |

Pig metal soft, moderately tough; dark mottled; fracture rough, without signs of crystalization. Cinder, a dark coloured opaque glass.

*Tabular view of the Analyses of Iron Ores of Bear Valley.*

| Specimen           | 1                              | 2          | 3          | 4                             | 5           |
|--------------------|--------------------------------|------------|------------|-------------------------------|-------------|
| Variety of ore.    | Argil carb.<br>and hyd. perox. | Hyd. oxid. | Hyd. oxid. | Argil carb.<br>and hyd. oxid. | Argil carb. |
| Specific gravity,  | 3.40                           | 3.347      | 3.286      | 3.48                          | 3.463       |
|                    | per cent.                      | per cent.  | per cent.  | per cent.                     | per cent.   |
| Loss by calcining, | 23.09                          | 11.40      | 11.13      | 12.52                         | 14.88       |
| Pig iron,          | 42.37                          | 51.35      | 51.60      | 53.05                         | 51.80       |
| Earthy matter, &c. | 34.54                          | 37.55      | 37.27      | 34.43                         | 33.32       |

The specimens above analyzed are all from near the outcrop of a bed, as indicated by the hydrated shell, or crust, on the exterior, and

are therefore richer in iron than the average of the same bed will be, when pursued under a sufficient covering, to yield the blue argillaceous carbonate in its unaltered state. It will then probably range somewhere between thirty-three and forty-two per cent. of metallic iron; give a loss of more than thirty per cent. by calcination, and contain, perhaps, twenty-five per cent. of earthy matter.

The distance from the point where I have proposed that a tunnel shall be commenced, to the Susquehanna river, is sixteen miles, traversed by the Lykens' Valley Rail Road. The superstructure of this road requires to be renewed with T rails, fit to bear transportation by locomotives, and the grading on one section to be altered so as to render the whole line either level or descending in the direction of the freight. This alteration will likewise improve the *plan* of the road, removing, or diminishing, several curves, and with these changes, it will, I conceive, be made one of the best railroads for descending tonnage in the coal regions of Pennsylvania. It terminates on the river at the mouth of Wiconisco creek, and at the commencement of the Wiconisco canal. This canal,  $12\frac{1}{2}$  miles long, connects with the Susquehanna canal at Clarke's ferry, is now nearly completed, requiring only one or two aqueducts and two or three locks to be made, with unimportant excavations to be finished, to place it in a condition to receive the water. Of an original estimate of \$416,000 for making this canal, \$364,500 have already been expended, leaving only a balance of \$51,500 required to complete the work. For this comparatively trifling sum, it is not to be supposed that the state will forego the advantage of receiving the great amount of tolls which this mineral region can bring, not only to the Wiconisco, but also to the whole line of state canal from Millersburg to Columbia, a distance of fifty-three miles.

The coal will reach tide water at Havre de Grace,  $98\frac{1}{2}$  miles from Millersburg, where it will have cost, agreeably to an estimate by Mr. Schaeffer, (which seems to me ample for every item of the expense, at least in the aggregate,) the sum of \$3.12 $\frac{1}{2}$  per ton. The boats used on this line of navigation will carry sixty-five tons, and being covered over with suitable hatches, may be towed to Baltimore, in which case, the coal delivered on the wharves need not cost over \$3.50 per ton.

In conclusion, I would remark, that I know of no other anthracite coal district among the many hitherto brought into active operation, which combines all the advantages possessed by that of Lykens' Valley. Its abundant supplies of coal and iron ore, its facilities for mining, the excellence and high repute of its coal, its fortunate connexion with a well located rail road, and at the end of that, with a capacious canal terminating at tide water, and having the Susquehanna river for its supply, with all the markets both of the south and east accessible during every month in the year, from the city of Baltimore, where the main depots of this coal will naturally be made, are circumstances which cannot be overlooked by any one who understands the value of a coal formation, or the innumerable purposes to which its treasures are applied.



## Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1840.

*With Remarks and Exemplifications by the Editor.*

1. For a method of *Channeling and Scarfing the Soles of Pumps, Shoes, &c.*; Lewis Baker, Fort Plain, Montgomery county, New York, September 2.

The apparatus used consists of an iron *form* of the shape of that part of the sole to be channeled and scarfed, which is to be tacked on to the said sole, and of two cutting instruments, one attached to each end of a handle. One of these has three knives projecting from the end of a block of iron, or steel—the outermost of which is sufficiently long to cut through the sole, and the other two of half that length, and as far apart as the width of the tongue to be formed. The other instrument is formed with a gauge, in place of the long outside cutter of the first instrument, and of two cutters that incline towards each other, their points being as far apart as the width of the tongue, so that they may cut out two parallel triangular strips of leather from each side of the tongue. An instrument used for making a channel on the inner side of the tongue, and scarfing the outer edge of the sole is also described, and is similar to the one last named, excepting that the cutter next the guard instead of inclining towards the other cutter, inclines in the same direction with it, and towards the guard.

The form serves as a guide in using the instrument. Claim.—“What I claim as my invention, and desire to secure by letters patent, consists in the combination of the cutting instruments with the form as before described.”

2. For an apparatus for *Boiling and Washing Rags*, used in the manufacture of paper; George Spafford, Windham, Windham county, Connecticut, September 2.

The patentee says—“In my improved boiler and washer, the rags are to be subjected alternately to the influence of high pressure steam and an alkaline liquid; said boiler being so constructed as to be capable of being made to revolve upon its axes, which are formed hollow, for the purpose of introducing steam from a separate, or ordinary engine boiler; and also of introducing water, or an alkaline solution, when desired, for the purpose of washing the rags which have been boiled.

“Having thus fully described the nature of the apparatus used by me, &c., what I claim is the construction and use of a cylindrical, revolving boiler, and washer, the interior of which is divided into four, or any other convenient number of compartments, by grated partitions, within which the rags are to be subjected to the action of high steam, and of an alkaline solution, in the manner, and for the purpose above set forth.”

Each of the compartments, into which the cylinder is divided, is provided with a hole, and cover, similar to that of the main hole of a steam boiler, for the purpose of putting in and removing the rags, &c.

- 
3. For an improvement in the machine for *Cutting Staves*; Isaac Hosmer, and William P. L. Badger, Concord, Middlesex county, Massachusetts, September 2.

This machine is designed as an improvement on that kind of stave-cutting machines which cut them from a block, or bolt, by means of a curved knife attached to radial arms, and the improvement consists in shifting the position of the axis of vibration, by having the axle to slide in slots in the arms, so as to make staves for barrels of greater or less diameter. The standards in which the axle has its bearings are also made to slide, that they may correspond to the change in the length of the arms without changing the position of the knife.

Claim.—“We claim the method of shifting the axis of vibration without changing the position of the knife, by means of the movable standards, in combination with the shaft, or arbor, and the slots in the radial arms, as described.”

- 
4. For an improvement in the machine for *Making Stove Pipes, Mouldings, &c.*; John Farrar, Cuyahoga Falls, Summit county, Ohio, September 2.

This patent is taken for a modification of the machine well known to sheet iron workers, in which the stove pipe is formed by rolling the sheet on a cylinder which works against a roller, the cylinder being provided with a groove along it, which receives one edge of the sheet of iron. The so called improvement consists simply in substituting for the roller, against which the cylinder works, a concave bed, which surrounds one half the circumference of the cylinder, and the claim is limited to the “employment of a cylinder with a groove, in combination with a concave bed.”

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5. For a machine for *Making Rivets*; Alpheus Fobes, Assignee of Charles Lyon, and Fitch W. Taylor, Assignee of Alpheus Fobes, Assignee of Smith Gardner, and Assignee of Charles Lyon, of New York City, September 2.

The claim is confined to the method of feeding the rod, and to the arrangement of the parts constituting the die plates; and as the claim refers throughout to the drawings, and could not be understood without them, we will merely furnish a general idea of the principal characteristics of the machine.

The tongs which hold, and carry the rod forward, are put in motion at each operation of the machine by a connecting rod, which receives motion from a pin, on the crank which actuates the leader. When the tongs are drawn forward to feed, a projection from the connecting rod first comes into contact with the levers, or handles, of the tongs, and causes them to gripe the rod, the whole then moves

together to the distance required to make the rivet; and on the return of the connecting rod, which is effected by a spiral spring wound around it, the levers of the tongs are first liberated, and then drawn back to be ready for a second operation. The die plate is provided with two dies, one permanent, and the other movable, and the rod passes through a hole in a plate, on the face of which the die plate slides. In the operation of the machine, the sliding die is first put in motion, which grips that end of the rod which is to be made into a rivet, the whole die plate then slides past the hole in the plate, on the face of which it works, thus cutting off the blank and preparing it to receive the blow of the heading die.

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6. For a machine for *Making Hook, or Brad-headed Spikes*; Henry Burden, Troy, New York, September 2.

The patentee says—"In my improved machine, the feeding in of the rod, the cutting it off, and the pointing of the spike, are effected in the way previously used by me for performing the same offices in my ordinary spike machines, or adopted by others; and my improvement for forming the spikes with hook, or brad, heads, may be applied to spike machines of various constructions.

"My improvement consists principally in the employment of what I denominate a bending lever, or some analogous device, by means of which a portion of the rod which is to constitute the head is bent down so as to form an angle with the shank, and in then forcing up a heading die, properly formed, so as to upset the bent portion, and to cause it to assume the desired shape."

The claim is limited to the bending that portion of the rod which is to be formed into a hook head, by means of the bending lever, and also in forming the heading die and the parts of the gripping dies, within which the bent part is to be upset, so as to give the proper form to the hook, or brad-head.

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7. For an improvement in the machine for *Cutting Veneers*; John Dresser, Stockbridge, Berkshire county, Massachusetts, September 2.

This machine, like some others, is to cut the veneer from a block, by means of a knife, the edge of which is forced against the block; the novelty consists mainly in so modifying it as to make it applicable to the cutting of veneers from a round log. Such a log is to be fixed to the mandrel of a lathe, and held by a centre screw; the knife is attached to a frame, or carriage, which slides on the bench at right angles to the axis of the log. As the log is put in motion the knife is forced up to it, and cuts therefrom a veneer, the thickness of which can be regulated by the change in the relative motions of the log and knife. The claim is limited to the manner of "cutting veneers with a knife from cylindrical blocks of timber, revolving in a common turning lathe, or other similar machine."



8. For an improvement in *Railroad Switches*; Nathaniel Eaton, Worcester, Massachusetts, September 3.  
(See specification.)

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9. For an improvement in the *Paper Engine*; William Dickinson, Worcester, Massachusetts, September 3.

Heretofore, the cylinder of the paper engine has been hung with one gudgeon in a permanent box, and the other in a box attached to a lever, called by paper makers a "lightener," and serving to elevate, or depress, the cylinder; but as this acted on one end only of the cylinder, an exact parallelism could not be preserved between the surface of the cylinder and the knife below it. To remedy this defect is the object of the improvement under consideration, and this consists in adding another lightener to the other side of the cylinder, and connecting the two together, so that in elevating, or depressing, the cylinder its surface shall always be parallel with the cutters below. To this improvement, or device, the claim is confined, and it would be difficult to confine a claim within narrower limits.

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10. For *Flower Pots, or Vases*; Joseph Adams, Boston, Massachusetts, September 3.

The vases, or flower pots, described, are to be made of wood, earthen, or stone ware, or of any other suitable material, if made of any material which will allow water to percolate through its pores; the vase is to be lined with metal. A metal vessel is made to fit within the vase, the lower part of which is of such diameter as to leave a chamber for water between it and the inside of the vase. The lower part of the inner vessel is perforated with a few holes, through which the water is supplied to the plant. The claim is confined to the inner vessel, constructed as described, in combination with a flower pot, or vase. If we have not seen, we have certainly dreamt of ornamental vases, or flower pots, so nearly like the foregoing that they might be mistaken for twins.

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11. For *Constructing, and Supplying Water to, Steam Boilers*; Cadwallader Evans, Pittsburgh, Pennsylvania, September 3.

The improvements described in this specification are applicable to that kind of steam boilers generally used on the large boats of the western waters, in which a number of cylindrical boilers are arranged side by side. The first improvement is in placing the pipes of communication between the respective boilers in the same tier above the tops of the flues within, so that when the boat careens, the water cannot flow from one to the other, below the tops of the contained flues, thus avoiding one of the causes of those accidents which are believed to arise from the over-heating of the flues when not covered by water. The second improvement consists in combining with the foregoing the manner of arranging the supply tubes so as to force the water into the outside boilers only, and at the same elevation with the tubes

of communication; thus insuring a sufficient and equal supply to all the boilers; the end boilers being always supplied up to the level of the communication pipes, no matter how much the vessel may careen.

The third improvement consists in placing a balance valve in the supply pipe, so constructed as that when the boat careens the weight of the valve will cause it to close the pipe that leads to the lowest valve, and thus force the whole supply of water to pass through the most elevated boiler.

The claim is confined to these three improvements.

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12. For a machine for *Separating Garlic from Grain*; William C. Grimes, York, York county, Pennsylvania, September 3.

The patentee says—"I proceed upon the fact, or principle, that the wheat, or grain, will completely resist any force which would be necessary to drive the garlic through a groove, or crevice." "But whatever may be the form or modification of the machine, I prefer, and use no other than projectile force."

A hollow, radial, chambered wheel revolves within a case surrounded by rings, which form conical openings, or grooves, all around, which either revolve in connection with the wheel, or remain fixed. The grain is fed into the hollow shaft of the wheel through an appropriate hopper, and is discharged by centrifugal force through the conical grooves formed by the rings.

Claim.—"What I claim as new, as my invention, and desire to secure by letters patent, is the mode of separating garlic, and other foreign matter, from wheat and other small grain, by means of the combined action of a hollow radial chambered wheel, and a series of rings, revolving in connection with, or remaining fixed around it, as herein set forth; the rings forming a narrow wedge-shaped groove, into which the grain, garlic, &c., is thrown by the radial wheel, when the separation ensues, as described."

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13. For an instrument for *Ascertaining the quality of Lamp Oil*; John W. Harris, Dorchester, Norfolk county, Massachusetts, September 3.

The improvement claimed consists in the oleometer scale, and in the manner of using it in conjunction with a thermometer. The scale consists of three parts, two of which are united together at their ends, and at such distance apart as to admit the third to slide between them. These are so divided as to indicate the specific gravity of different specimens of oil, and at certain degrees of temperature, which are indicated by the thermometer.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the oleometer scale, also the mode of ascertaining the quality of spermaceti oil at any particular temperature, by means of the aforesaid scale, in combination with the oleometer and thermometer, as herein set forth. I disclaim as my invention the oleometer itself."

14. For a *Cement for Covering Buildings, Floors, Steps, Sidewalks, &c. &c.*; Jacob Bump, Kirtland, Ohio, September 3.

The following are the ingredients which are to compose this cement, viz. "To one bushel of clean sand add half a bushel quick lime, one eighth of water lime, one eighth of pulverized hard stone, granite or clean gravel, half a gallon of hot tar, one pound of copperas, one pound of alum, one eighth of a bushel of furnace, or smith's cinders. Pulverized glass will answer." "The above ingredients to be well mixed together, and after one day, or more," we are told, "it will be fit for use, to be kept tempered, and to be spread like mortar."

The claim is limited to the composition of cements formed of the afore named ingredients. We can scarcely imagine a mixture more heterogeneous.

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15. For an improvement in the method of *Opening and Closing Window Blinds*; George Butterfield, Hopkinton, Merrimac county, New Hampshire, September 4.

This patent is for a method of opening and closing those window blinds which slide horizontally. A bar extends across the window, about midway of its height, which bar is embraced by plates attached to the inner edge of each half blind; each section of the blind has a rack affixed to it, which racks are actuated by the leaves of a pinion fitted in the window frame, and provided with a winch, by which the whole is operated.

The claim is to the "mode of opening and closing blinds by the combination of the bar, racks, pinion, and crank, as described."

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16. For an improvement in the *Stencil Plate* for facilitating the painting of signs, marking boxes, bales, goods, &c.; Edwin Allen, Windham, Connecticut, September 4.

Two grooved strips are joined together at their ends so as to receive separate plates of metal, in each of which is cut a distinct letter, which may be set up and changed at pleasure. The frame, with the plates, or letters, is placed upon the article to be painted, or lettered, and the brush passed over the letters, or plates. The claim is to the "combination of the perforated plates and frame, as before described, for marking boxes, bales, &c. &c."

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17. For an apparatus for *Transmitting Heat by the Circulation of Hot Water*; Angier M. Perkins, a citizen of the United States, now residing in London, England, September 4th, 1840; antdated August, 1838, date of English patent.

The patentee says—"My invention consists in transmitting, or transferring, the heat from the fire to the aforesaid water, or other fluids, by means of the circulation of water in tubes closed in all parts, and as letters patent under the seal of the United States, have heretofore been granted to me for warming the air in buildings, and also for



heating water, and other fluids, by means of the circulation of water in tubes closed in all parts, and moreover, as the circulating hot water tubes which I now propose to employ, are, in many respects, similar to those for which the aforesaid letters patent were granted. Now, I declare that my present improvements are intended to make such addition to the aforesaid circulating hot water tubes, and such alteration thereof, as shall render them more fully applicable to the several purposes before mentioned." "I claim as new the following parts of the apparatus, viz. Firstly—The combining of a force pump with the circulating tubes, arranged and combined as set forth, closed in all parts, excepting in that for the admission of water from said pump. Secondly—The supplying the tubes with water by means of a valve opening inwards, within a cistern constructed and operating substantially, as described; the water being thereby allowed to enter said tubes by its own gravity, or by atmospheric pressure, whenever a deficiency arises from either of the causes within enumerated. Thirdly—The combining with said apparatus what I have denominated the expansion, or safety valve, for allowing a portion of water to flow out of the tubes when expanded by heat. Fourthly—The employment of a portion of the circulating tubes of my system of closing tubes, to constitute fire bars, as set forth; not intending to claim as of my invention the using of hollow fire bars communicating with a steam boiler, this having been before done. Fifthly—The manner of using the expansion and contraction of one of the hot water tubes, in combination with my system of circulating tubes, as a heat governor, or regulator, whereby the fire is kept at any required degree of intensity, and the tubes at any required temperature."

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18. For improvements in the machine for *Moulding and Pressing Bricks*; Stacy Costill, Philadelphia, Pennsylvania, September 4.

This machine consists of a circular platform, with hollow trunks extending down from it to the top of a revolving plate, containing the moulds and pistons. The shaft of this revolving plate passes up through the centre of the platform, and at the top it receives, and gives motion to, a spindle, the arms of which carry the tempered clay into the hollow trunks, through which it is conducted to the moulds in the plate below. As the plate revolves, the moulds are brought under the trunks, and receive the clay, and as they move on they pass under an arm, which is jointed to the shaft of the plate, and which, by a catch, becomes united to, and moves around a portion of the circuit with the mould, thus constituting its top. During this portion of the circuit the piston is forced up against the arm, or false top, by passing over a circular cam below the plate, and as soon as the brick is pressed the catch disengages the arm, which is carried back by a spring to the side of one of the trunks, to be ready for the next mould; as soon as the mould is relieved of the arm, the piston is forced up by an elevation on the cam, which discharges the brick. There may be any number of moulds and trunks, there being one arm for each trunk.

The claim is to "constructing the platform with vertical trunks, in combination with the revolving spindle. Also the movable arm, in combination with the revolving plate and stationary cam, (which disengages the arm from the mould,) the arm being connected to the plate, and revolving with it while the brick is being pressed, and being detached from it as soon as the pressure is completed, as described."

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19. For an instrument for *Delineating Maps, Charts, &c.*; Amity Bailey, Newburg, South Carolina, September 4.

This instrument consists of a parallel ruler attached to a ring, which revolves with a graduated circle, divided into degrees, and parts of degrees. Each end of one of the rules is attached to the ring, the other being at liberty.

The claim is confined to the "parallel ruler, in combination with the ring and graduated circle," for the purpose, and in the manner described.

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20. For an improvement in the *Paddle Wheel for Propelling Boats*; Francis W. Stevens, Chigwell, Essex county, England, September 5.

This patent is obtained for an improvement on that kind of paddle wheels which has the floats inclined at an angle of from thirty to sixty degrees; the improvement consists in a method of adjusting and changing the angle at any time. Each paddle is affixed to, and revolves on a radial axle, the outer end thereof being supported by a ring. The mode of attaching the paddles to their radial axles is by boxes, so as to allow the paddle to revolve; but when the proper and desired angle has been attained, the boxes are to be screwed tight; the outer angles of the paddles on each side are then jointed to a ring, or a series of braces, so as to retain them at the desired inclination.

The claim is to the "arrangement of the wheel, and of the floats, or propellers, by which their adjustment is effected, in the manner, and for the purpose described."

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21. For a mode of *Cutting Grass under Water*; Jacob Hinds, Hindsborough, Orleans county, New York, September 5.

Two scythes are attached by their heels to a bar of iron, which forms a handle—the scythes diverge in nearly opposite directions, so that their points will be about six feet apart. The handle is held by a person at the stern of a boat, the scythes dragging on the bottom, and as the boat moves they cut the grass.

Claim.—"I do not claim to be the inventor of the scythe, but what I do claim is the connecting of two scythes at their heels, and to a bar of iron, &c., for the purpose, and in the manner described."

22. For an improvement in *Door, and other Locks*; Augustus Prutzman, Philadelphia, Pennsylvania, September 5.

In this lock the same bolt is used for a spring latch and lock bolt, and when employed as the latter it is shot out farther than when used as the former. The bit of the key contains a set of levers, or tumblers, operated upon, and thrown into their proper position by a slide, or slides, actuated by a small additional key, which enters the barrel of the main key. Each lever is provided with a notch corresponding with a notch in the bit of the key, which latter cannot turn until, by the proper application of the small key, they are all made to coincide.

The bolt, when employed as a latch bolt, is actuated by a right angled lever, on which the cams of the knobs severally act, and when the bolt is to be thrown back it acts against one end of the tumbler, which is jointed to the bolt, so that as the tumbler is forced back by the lever the bolt must follow; but when the bolt is shot forward as a lock bolt, the end of the tumbler cannot be acted upon by the lever, and hence the knobs have no effect upon it.

Claim.—“What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have constructed, arranged, and combined the slides and safety levers contained within the parts which I have denominated the barrel and bit, so as to be operated upon respectively by the offsets on the end of the key, by which the notch in said levers are made to coincide with the notch in the bit, thus allowing the bit and barrel to be carried around by means of the key, and the spring bolt to be carried forward, or moved back, as a lock bolt.” “I also claim the particular arrangement of the parts which operate upon the bolt as a spring bolt, in combination with each other; said combination consisting of the double, (or right angle,) lever, acted on by both of the cams, or fallers, of the respective knobs, said lever acting upon the bolt through the intermedium of the tumbler, the whole combined and operating substantially in the manner set forth.”

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23. For an apparatus for *Containing and Preserving Meat in Market*; Adam Letzer, Baltimore, Maryland, September 5.

This apparatus consists of a refrigerator of the usual construction, having within it two zinc tubs for salting meat, and a bench and “block” placed on trucks, so that when not used it can be wheeled up against the refrigerator, and the two locked together. What the patentee calls a block is a bench, boarded up all around, except on the side towards the refrigerator, and within this the scales, tools, &c., are placed. The claim is to the “combination of the refrigerator, zinc salting tubs, and motive block, for the use of victuallers at the markets, or other places.”

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24. For a *Locomotive Cylinder Printing Press*; Charles J. Carr and Andrew Smith, Belper, Derby county, England, September 10.

In this press the form of types is placed upon a permanent bed, and a roller passes over it to give the impression. The roller has its gud-



geons in boxes working in a sliding frame, each end of which is provided with ink-spreading rollers, which receive the ink from an inking apparatus at each end of the machine, when the roller stops, preparatory to returning. The paper is fed in by a system of threads, a delivery board, receiving roller, &c., which conduct the paper between the impression roller and the ink-spreading rollers. There is a peculiar arrangement for registering; but as the whole could not be clearly described within the limits of a notice, and as the claims refer to, and could not be understood without drawings, we will merely add that the claims are limited, first, to the peculiar arrangement of parts for supplying, conducting, and delivering the paper; secondly, to an improvement in the inking apparatus, by which it is adapted to the peculiar structure of the machine, and thirdly, for an arrangement of the parts for effecting a register, as in book, or other work.

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25. For a method of *Uniting Canal Boats when made in Sections*; Robert Frazer, Waynesburgh, Mifflin county, Pennsylvania, September 10.

The boat is made in sections, each section being water-tight. The sections are to be united together two abreast, and three in a line, by means of iron yokes, which embrace the bows and sterns, and by eyes and staples for the middle sections. The bow and stern sections are so formed that when two are put side by side they constitute a proper bow and stern.

Claim.—“What I claim, and desire to secure by letters patent, consists first in placing the boats two abreast; and second—the mode of fastening the sections together when floating, by the yokes and screws, as described.”

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26. For an improvement in the *Brake for Railroad Carriages*; Peter J. O. Conway, Philadelphia, Pennsylvania, September 10.

This brake consists of a shoe which is to be pressed against the tread of the wheel and the rail. It is suspended to a spring bar of metal which is attached to the frame of the carriage, and curved over the wheel. The brake is pressed against the wheel and rail by means of a lever jointed to it, and extending up so as to be within the reach of the tender, and when liberated it is drawn up by the spring. Claim.—“I do not claim to be the inventor of a brake, or drag, in which the shoe presses against the road and the periphery of the wheel at the same time, this having been known and used before, but I do claim as my invention attaching the shoe to a spring bar, in the manner, and for the purpose specified.”

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27. For an improvement in the *Spark Arrester*; Leonard Phleger, Philadelphia, Pennsylvania, September 10.

Outside of the common chimney is a casing extending from the top of the boiler to about eighteen inches above the top of the chimney, the lower half being cylindrical, and the upper spreading out

conically, leaving a space between the two, which is occupied by a perforated case, the lower portion of which is cylindrical, and the upper part conical, to correspond with the outside casing, excepting about a foot of the upper part, which is cylindrical, and not perforated. The top of the arrester is closed, excepting a hole in the middle, equal in diameter to that of the chimney, which opening is provided with a conical cover, so hinged to it as that when closed the apex of the cone will be downwards, and immediately over the centre of the chimney. The bottom of the perforated tube extends to within a foot or two of the bottom of the chimney, where the space between it and the outside casing is closed by a plate, and the space between it and the chimney is left open. From the space between the chimney and the outside case, below the perforated tube, an elbow pipe extends to a box for the reception of the sparks. The outside casing is provided with a number of elbow pipes of different lengths, opening into the space between the outside casing and the perforated tube above and below, there being two sets, one long, and one short.

The patentee thus describes the operation. "When the engine is in operation the cover is to be fastened down by means of a loop on the end of a rod. The operation will then be as follows. After the heated air, sparks, and steam, have passed up the flue, or chimney, the direction of the draught is turned downwards, between the chimney and the perforated cone; the sparks have but little tendency to pass through the perforations, but are driven down, with a portion of the steam, into the space, and thence through the elbow pipe into the receptacle, where, by the closeness of the receptacle and the action of the steam, they are soon extinguished. The gaseous products of combustion pass through the perforations into the flue space surrounding them, and through this, and the double elbow pipes, into the atmosphere. What I claim, &c., is the forcing of the sparks to descend between the flue and the perforated cone into the space, and thence through the pipe into the spark receptacle, in the manner, and in consequence of the combined operation of the respective parts, constructed as set forth."

"I also claim the forming of the flue space on the outside of the perforated cone, constructed as described, by combining with the space between said cone and the exterior case, a number of pipes, or tubes, in the manner, and for the purpose set forth."

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28. For an improvement in the *Corn Cultivator*; Noah Barnes, East-hampton, Suffolk county, New York, September 10.

This improvement in the cultivator consists in a long share, which extends from a point where the coulter and a land-side are united, to the back; the land-side and share forming an acute angle. The two consist each of a narrow bar of iron, the latter being sharp at one edge. They are attached to a triangular frame, one side of which projects sufficiently beyond the triangle to form the beam. To the back piece of the frame, which forms one side of the triangle, and to an intermediate cross piece, teeth, similar to harrow teeth, are at-

tached. The land-side, or bar, is placed under that side of the triangular frame which forms the beam. The claim is to the "combination of the share, teeth, and frame."

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29. For an improvement in the *Alarm for Time Pieces*; Benjamin Knight, Slatersville, Providence, Rhode Island, September 10.

This alarm is to be started by a detent on the arbor of the minute hand, which, at every revolution, lifts a lever, to which is suspended a rod, having a hook at its lower end that catches on to the teeth of a wheel, and at each operation carries it around one tooth. This wheel has twenty-four teeth; and on its face it is divided into as many parts, marked in two series, from one to twelve, there being a hole on the face to correspond with each division, into which a pin may be inserted. The pin is inserted in the hole corresponding with the hour at which it is to give the alarm. The wheel is turned one notch at each hour, and at the given hour the pin lifts a lever, and this a second lever, which is weighted, and is connected by means of wires and bell cranks with the bell, which is to be rung.

The claim refers to the drawings, and is limited to the arrangement and combination of the parts consisting of the detent on the arbor of the minute hand, the rod which actuates the notched wheel, the latch lever, and the weighted lever, as described.

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30. For a machine for *Cutting Staves*; Cephas Manning, Acton, Middlesex county, Massachusetts, September 10.

In this machine the knife is curved in the direction of its cut, so as to cut staves suited to the diameter of the barrel; the knife is attached to two blocks, one at each end, which slide in curved grooves in the frame, instead of being attached to two heads working on an axis; the knife is actuated by a lever. The claim is to the arrangement above described.

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31. For a machine for *Dressing Cotton Waste and Rags*, previous to the same being reduced by the cutting machine and common duster; Emery Smith, North Sudbury, Middlesex county, Massachusetts, September 10.

This machine consists of a cylinder, with two rows of double pointed teeth on opposite sides, so arranged that the teeth in one row shall be opposite the spaces between the teeth in the other row; these teeth are all curved in the same direction. A row of wire teeth projects from the side of the case in which the cylinder revolves, and these are so arranged that the point of each tooth will pass between the forks of the teeth on the cylinder as it revolves. A wire concave is placed below, sufficiently low to avoid the teeth on the cylinder. The cylinder is provided with two fast and loose pulleys, and with two straps, by means of which it may be made to revolve in opposite directions.



The claim is to the cylinder with angular forked teeth, in combination with the teeth in the case and the wire concave.

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32. For a *Sugar Mill*; Nathan Sargent, Cambridge, Middlesex county, Massachusetts, September 10.

The sugar is ground by a cylinder armed with rows of teeth which run spirally around one half of its circumference in one direction, and in the reverse direction on the other half. The teeth are thus arranged to enable a scraper to scrape away the sugar which adheres to the surface of the cylinder between their rows; this scraper is placed in slides below the cylinder, and is notched, to correspond with the rows of teeth. As the cylinder revolves, the teeth come into contact, in succession, with the whole surface of the sugar in the hopper, and the scraper removes that which adheres between the rows of teeth, said scraper receiving a reciprocating motion from the teeth. Were these arranged in rows in the direction of the circumference, they would not act on the whole surface of the sugar, and if they were arranged in continuous helices the scraper could not act on the surface of the cylinder between the rows of teeth.

Claim.—“I claim a cylinder having its teeth disposed in advancing and receding helices, in combination with a scraper.”

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33. For an improvement in the manner of *Attaching Glass Knobs to their Sockets*; Francis Draper, East Cambridge, Middlesex county, Massachusetts, September 10.

The lower part of the knob is made conical, the larger part thereof being towards the socket, a strip of metal is bent around it, and the ends soldered together, and attached to the glass by cement, or other means. This part, thus surrounded with metal, is put into the metallic socket, and the two are then united by soldering.

Claim.—“I claim as my invention, connecting the glass knob to the socket, through the intervention of a conical metallic ring affixed to, and surrounding the lower part of the knob, and soldered to the socket.”

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34. For improvements in the mode of *Pressing and Finishing Straw Hats and Bonnets*; William Chaplin, City of New York, September 10.

The top, crown, and brim, of the hat are pressed separately, and for this purpose, press, or dye, blocks of wood, of the proper form, and previously moistened, are used in connection with polished metal matrixes, provided with heaters. For the crown the matrix and block are conical, as are also those for pressing the rims and fronts, and for the top, of any form to suit the fashion. The block and matrix are placed, with the article to be pressed between them, in a hand press, very similar to the common hand printing press.

Claim.—“First—the application of countersunk heated metal disks,

for pressing and finishing the crown tops of hats and bonnets, in combination with the dye block, as described."

"Second.—The mode of forming the conical matrixes and heater boxes with heaters, and the combination of the same with the conical dye block, when such combination is applied to pressing and finishing the sides of bonnet, or hat, crowns, as described."

"Third.—The employment of the conical dye block for pressing the brims, or fronts, and also the employment of paste board, to give equal pressure, as described."

"Fourth.—The mode of forming the conical matrixes and heater boxes with heaters, for pressing bonnet, or hat fronts, or brims, and the combination thereof with the curved conical dye block, when such combination is employed for the purpose of pressing bonnet, or hat fronts, or brims, or articles of a similar nature, made of vegetable substances, as herein described."

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35. For a *Machine for Cutting Staves*; Oliver Sheldon, New Marlborough, Berkshire county, Massachusetts, September 10.

The improvement is on that kind of stave cutting machines, that cut by means of a knife attached to two heads on a shaft, the knife being curved in the direction of the cut, so as to give to the stave the proper form for the diameter of the barrel; the improvement consists in attaching to two arms on the shaft, to which the stave cutting knife is attached, two sets of cutters for forming the champher and groove at each end of the stave, and for cutting off their ends. The claim is confined to these cutters in combination with the revolving knife for cutting the stave.

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36. For an improvement in the *Machine for Cutting Staves*; Caphas Manning, Acton, Middlesex county, Massachusetts, September 14.

This machine cuts a stave in a manner similar to that noticed in the preceding article, but without the improvement therein mentioned as the subject of the claim. The improvement claimed in this patent consists in combining with the revolving cutter for cutting staves a mode of working the carriage to feed the block up for every stave cut. In the machine described two cutters are used.—The block of wood is properly attached to a carriage by means of dogs—the carriage has a rack under each end into which two pinions on a shaft mesh, and is so connected, by means of suitable gear, with the shaft of the cutters that the block is fed up, after one knife has passed through the wood, to receive the cut of the other knife.

The claim is to the "arrangement of the knives in combination with the arrangement of machinery for moving forward the carriage as the staves are cut."

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37. For an improvement in the *Horse Power*; Charles Hibbard, Guilford, Stafford county, New Hampshire, September 14.

Two vertical shafts placed at a considerable distance apart, have a

band or rope passing around them, to which the horse, or horses, are attached, so that they draw in a straight line except in passing around the wheel at each end. From one of the shafts the power is communicated by means of bands and band wheels to the machinery to be driven. The claim is confined to this device.

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38. For an improvement in the *Two Wheeled Carriages, called Cabs*; John Page, New York city, September 14.

The improvement in this cab consists, first, in carrying a bent axle along the sides and around the front or back of the body; and when carried around the back, in bending it down so as to pass under the door, and in attaching the shafts to the bent part of the axle, and connecting the body of the carriage with the bent axle by means of the springs only; and secondly, in arranging the seats diagonally and in having the door in one of the corners so that two persons can sit in a less space than when the seats are ranged entirely across.

Claim.—“What I claim is the manner in which I have combined and arranged the bent axle, the shafts, the springs and the body of the carriage, or cab, with each other, the bent axle being carried either in the front of or behind the body, as herein set forth. I also claim in combination therewith, the manner in which I have arranged the seats and the door, by placing the former in opposite corners and the latter on one side, as set forth.”

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39. For *Key Bands for Tobacco Casks*; James M. Talbott, Richmond, Virginia, September 14.

This band has a plate on one end with a mortise through which passes a tongue attached to the other end of the band—the tongue also has a mortise in it through which passes a key by which the band is drawn tight after it has been put on the cask.

Claim.—“What I claim as my invention is constructing the key band with a mortise plate in combination with the tongue and wedge.”

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40. For a machine for *Extracting Stumps*; Lewis and Charles Howard, Reading, Steuben county, New York, September 14.

A chain made fast to the stump is attached to, and winds on a windlass or shaft on which there are two ratchet or rag wheels which are actuated by two hands worked by combinations of levers, there being three levers in each combination. At the end of the frame of the machine towards the stump, two large pieces of timber called anchors, and properly shod, are hung by hinges, and these are forced into the ground and prevent the machine from being drawn towards the stump.

Claim.—“What we claim as our invention and desire to secure by letters patent, is the manner in which we have arranged the levers, in connection with the machine, and their further combination with the bands, wheels, anchors and chain.”



41. For improvements in the *Floating Dry Dock*; John L. Gilbert, New York city, September 19.

This floating dry dock is so constructed that it may be used either for the purpose of repairing vessels or for floating them over bars or shoals. It is constructed with water tight cases, or trunks, on each side of the body, or floating chamber, of the dock, and these are divided transversely by means of water tight bulkheads; the whole of these are connected with each other, and with a pump well, by means of pipes governed by cocks, so that water can be let into, or pumped out of any or all of them by means of a steam engine, which may also be used for pumping the water out of the body of the dock, and for propelling it when used for floating vessels over shoals, &c.

Claim.—“What I claim as my invention and desire to secure by letters patent, is the combination of the body of the dock in which a ship can float, with water tight trunks, or tanks, at the sides separated by water tight bulkheads, for the purpose and in the manner set forth.”

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42. For improvements in the *Cooking Stove*; James Still, Zanesville, Muskingum county, Ohio, September 19.

In this stove the flue passes over the top and under the bottom, and up the back of the oven, the draught being caused to pass along both flues at the same time by extending the top plate back so as to divide the collar, which receives the stove pipe, into two parts. A hole is made in the bottom plate of the stove opening into the bottom flue and is provided with an ash box into which the dust falls in cleaning out the stove.

Claim.—“First, the mode of forming a double draught by extending the top plate of the oven back so as to divide the collar to which the smoke pipe is attached into two parts, for the purpose of allowing a draught above and below the oven at the same time, as described. Second, constructing a flue under the oven with an opening at its bottom and adapting thereto a movable box, as set forth.”

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43. For a *Machine for Cleaning Grain*; Edward Bradfield, Rochester, Monroe county, New York, September 19.

Within a cylindrical casing, formed of wood or iron ribs, and of wire gauze, what the patentee denominates a beating cylinder, is made to revolve; this cylinder is constructed by extending arms radially from a vertical shaft at its middle and near its two ends, by affixing a hoop or ring to the ends of these arms, by covering the two end hoops with wire gauze, and by securing to the edges of these hoops four metallic plates, having their edges turned at right angles so as to stand out radially; these plates have teeth cut on them, and are so tempered as to give them elasticity. Between each of these plates there is another plate running from end to end of the beater cylinder, its edge standing out radially and as far from the center of the shaft as the point of the teeth on the first named plates. A plate of metal is placed on the shaft, below the lower disc, or end, which

plate is made to form vanes, which force a current of air up into the beater cylinder. The grain is fed in at the top, and in descending it is operated upon by the beaters and the current of air.

Claim.—“What I claim as my invention and desire to secure by letters patent is, the constructing of the revolving cylinder with elastic teeth, as herein set forth; also in combination with the above, the radial plate at the bottom of the machine, in which is combined their self regulating power, so as to effect the greatest possible good for the purpose intended.”

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44. For improvements in the *Coffee Mill*; L. R. Livingston and Calvin Adams, Pittsburg, Pennsylvania, September 25.

This mill is of the old fashioned kind, with a nut revolving in a shell, and the improvements claimed are three in number. The first consists in a mode of casting the hopper, shell and arch piece in one piece. From that part of the hopper where the shell commences three pieces rise, approaching each other until they unite in a collar for the spindle to work in. The second, is the mode of attaching the mill to a table, or shelf, by means of a projecting plate, cast with the hopper, and with jogs on its under side to stick into the wood, and a hook which catches against the underside of the table, or shelf, the shank of which passes through a hole in the plate, and receives a nut on its end by which the plate and hook are drawn tight together, embracing the table or shelf between them. The third improvement is in a method of regulating the cut of the mill—this is effected by passing the spindle of the nut, or cylinder, through the collar of the arch, and instead of letting the handle rest against a shoulder on the spindle, it bears on the top of the collar—the thumb nut which screws on to the end of the spindle, draws the grinder up, in consequence of the handle resting on the collar of the arch. Or the same thing may be effected by attaching the handle to the spindle permanently and having a thumb screw to pass through the handle and rest on the collar of the arch. The claim is confined to these devices.

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45. For an improvement in *Door Locks*; Peter Rogers, Philadelphia, Pennsylvania, September 25.

The patentee says—“the improvement consists in the manner in which I construct and combine the spindle and knobs of the spring bolt with the fallers, or followers, which operate upon the lever and retract the bolt so as to simplify the structure of this part, and improve its action. I construct the inside faller, or that which is next to the lock plate, with a hollow barrel, or cylindrical socket, which projects out from the face of the lock plate, upon which barrel, or cylindrical socket, I fit the inside knob of the spring bolt. The knob spindle is made cylindrical where it passes through the inside faller and into said barrel, and has a groove turned in it to receive the point of a screw which passes through the inner knob, and through the barrel, attaching them together, and holding the knob spindle in place.”

Claim.—“I claim the constructing, combining, and arranging of the

socket, the inner faller and the inner knob, in the manner and for the purpose herein set forth, so that the two knobs may act independently of each other. I do not claim the mere making of the inner knob to act upon the spring bolt independently of the outer knob, this having been done in other modes, but I limit my claim to the effecting this object substantially in the manner made known."

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46. For a *Self Acting Mule for Spinning Cotton*; Daniel P. Lapham, administrator of Benjamin Lapham, Adams, Berkshire county, Massachusetts, September 25.

This is of necessity a complex machine, the description of which runs through thirteen pages of folio, with numerous drawing. An attempt to give even an account of its characteristics would lead us far beyond our limits, and without the aid of drawings it would be useless to attempt a description of it. We are under the necessity of omitting the claims as they refer throughout to the drawings and could not be understood without them.

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47. For a *Cotton Press*; James A. Potter and James E. Kelsey, the former of Providence, Rhode Island, and the latter of Poughkeepsie, New York, September 25.

This press consists principally of two endless chain platforms somewhat similar to those made for endless chain horse powers, these platforms are so arranged, one above the other, that at one end they approach more nearly together than at the other:—their distance apart being regulated at pleasure. The bale which is to be repacked is received between them at the end where they are farthest apart, and in passing through as the platforms revolve, it is compressed. This machine is intended only for repressing bales of cotton, hay, &c., for the purpose of making them occupy less room in stowing on board ship—and it is made portable so that it can be taken to a wharf when a vessel is to be loaded.

Claim.—“What we claim as our invention is the employment of two revolving endless chain platforms so constructed as that they shall be nearer together at one end than they are at the other, &c., as described.”

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48. For improvements in the *Cooking Stove*; Samuel L. Chase, Woodstock, Windsor county, Vermont, September 25.

In this stove there are two, three, or more ovens, and these are arranged two in height with a flue between them. The draught passes out from the fire chamber into the flue between the top and bottom ovens, then over the upper oven, or ovens, thence down one end to the flue under the lower oven, or ovens, thence to a rarefying flue under the fire chamber (to insure a draught) and out at the exit pipe. The hearth in front of the fire chamber is sunk, and is provided with bars, for coal, and holes below the bars for draught, it is also provided with a cover, having holes for boiling, &c., which is hinged so as to swing



off and on. That part of the cover on the sunk hearth which runs along below the door of the fire chamber is notched, and the bottom of the side door is provided with an inclined piece, the two forming a flue, from the coal undergoing combustion in the sunk hearth. The cover of the hearth may be made in two parts, each half being hinged so as to swing off on the two sides of the stove.

Claim.—“Having thus fully described the nature of my improvement, and shown how the same is carried into operation, and having in so doing shown and described many parts and devices, of which I do not claim to be the inventor, I now proceed to state what I do claim, and desire to secure by letters patent, viz: first, the manner in which I have combined and arranged the flues, including the rarefier as set forth, that is to say the admitting of the heated air from the fire chamber into the flue between the upper and lower ovens, conducting it thence through the flue above the upper oven, thence through the flue at one end to the flue under the lower oven, thence into the rarefying flue under the fire chamber, and thence into the exit pipe, all as herein made known. Secondly, I claim in combination, the arrangement of the respective parts of the hearth for boiling and other cooking operations, which arrangement consists of the sunk hearth furnished with the bars, the openings for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, as described.”

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49. For a *Cot, or Cross Bedstead Sofa*; Girard Sickles, Middletown, Middlesex county, Connecticut, September 25.

The following is the claim on which this patent was granted, viz: “What I claim is the contrivance of converting a common cot, or cross bedstead, into the shape of a sofa, or settee, and vice versa, by means of an additional joint in the upper part of one of the cross stanchions, or legs, at each end of the cot, combined with arms and frontispieces, all constructed, fitted, and adapted to each other as described.”

When the sofa is used as a bedstead the jointed stanchion is straight, a cloth, sacking, or leather bottom is stretched from a bar running from the upper ends of the two stanchions on one side, to the bar on the upper end of the stanchion on the other, in the manner of a common cot bedstead. When it is used as a sofa, the jointed end of the two stanchions, which are in the front of the sofa, turn down and form the fronts of pillasters; this brings the bar, to which the sacking is attached, down to the proper height for a seat, and the sacking lies in a proper curve to form the seat and back, the bar on the other stanchions being elevated by this change. The necessary means are provided for locking the parts in their proper position, and for ornamenting the article.

## SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a Patent for an Improvement in the Construction of Railroad Switches. Granted to NATHANIEL EATON, of Worcester, Massachusetts, on the 3rd of September, 1840.*

Be it known that I, Nathaniel Eaton, of Worcester, in the county of Worcester, and state of Massachusetts, merchant, have invented a new and useful improvement in the construction of railroad switches, called "Eaton's Improved Railroad Switch," of which the following is a full and exact description.

The improvement is applied to the railroad switch in common use, which is formed by two rails connected by transverse rods of iron, and which may be shifted from one set of permanent rails to meet those of a different track, by means of a lever. The improved switch is made with two, or more rails, to accommodate to the number of tracks or diverging rails, which may be used. It may be placed on a platform of wood, or metal, over the superstructure of the road, or may have the rails connected together by iron rods, with screws and nuts to hold each of the rails in their places, and to adjust them in case of any change of position, occasioned by accident, or by the variation of temperature. The improved switch is constructed with two, or more rails. On the outside are placed two rails, commencing at the end next to the chair in which they rest, or the hinge by which they are shipped; these rails are formed like the common rails of the road; they are straight, until they reach about to the middle of the length of the switch, and are then bent slightly outwards. Within these outer rails, and at such distance within them as to admit the passing of the flanch of the car wheel, is fixed another rail; this is fastened to the head of the switch by a bolt, on which it turns as upon a pivot; it is formed of the usual thickness and size of the road rail, for about three or four feet from the head, and then tapers on the side to an edge, or point, having a wedge shape. This is called the safety rail; and is of such length, and tapers in such manner, as that when the small end is pressed against the outer rail, where that curves outward, that the inner surface of the safety rail forms a straight line with the permanent track. This safety rail is pressed strongly against the inner face of the outer rail by a spring placed so low beneath the upper surface of the rail as to lie beneath the flanch of the car wheel, or it may be bolted to the outer rail, or so secured by the other attachment as to act against the safety rail, and to bring it in contact with the outer rail. The safety rail may slide on smooth iron plates, or be moved on friction rollers, or on rods of iron connecting the rails together.

On the inside of the safety rail is fixed another rail, shaped like a wedge, tapering on the sides to an edge, two or three feet long, and continuing the permanent rail. This rail is bolted at the head of the switch; beyond it, extending towards the hinge end of the switch, is

a guard rail of the common form, to guide the wheels on the track, and prevent their striking against the edge of the safety rail.

The construction of the improved switch, which has been described, is fitted for only two permanent tracks; but the switch may be adapted to any required number of tracks, by increasing the number of rails on the switch, and providing a safety rail and spring for each additional set of rails, in the manner before described.

The switch is moved and regulated by the lever and rod applied to the common switch.

In the use of the improved switch the safety rail is placed against either of the main, or diverging tracks of the railroad, and at least two of the permanent rails are covered. As the cars proceed in the direction from the hinge to the head of the switch, they will be directed on the track covered by the safety rail, and will be prevented from running off from the rails; when they move in the opposite direction, they must be carried upon the permanent rails, because the end of each of those rails is covered and continued by the switch rails. Although the switch may not have been moved, the flanch of the car wheel, if running on the outer rail, will move the safety rail so far as to admit of the free passage of the cars, and after the train shall have passed the spring will restore the safety rail to its place.

The accidents which have occurred in the old mode of constructing, cannot occur in the improved mode of building switches, which has been specified; for the safety rail, adjusting itself, will always furnish a continuous line, and prevent the cars from running off from the track. Another great advantage of the safety rail is, that the cars on many diverging tracks, will be carried upon one line of rails without the care and labour of adjusting the switch for each. What the said Eaton claims, and desires to secure by letters patent, is the mode of constructing switches with a movable rail, operating by a spring, or weight, or otherwise adjusted, in the manner before described, so as to cover two, or more, permanent railroad tracks.

NATHANIEL EATON.

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*Specification of a Patent for a Means of Producing Adhesion between the wheels of Locomotive Engines and the rails of railway tracks. Granted to JORDAN L. MOTT, of the city of New York.*

To all whom it may concern: Be it known that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented a new and useful method, or apparatus, for the purpose of producing adhesion between the wheels of locomotive steam engines and the rails of railway tracks, by which device such engines will be enabled to overcome the resistance arising from ascending grades without its being necessary to throw any additional weight upon the wheels for that purpose, and I do hereby declare that the following is a full and exact description thereof.

My improvement consists in the combined application of moisture and of sand to the wheels, by means of which the sand may be dis-



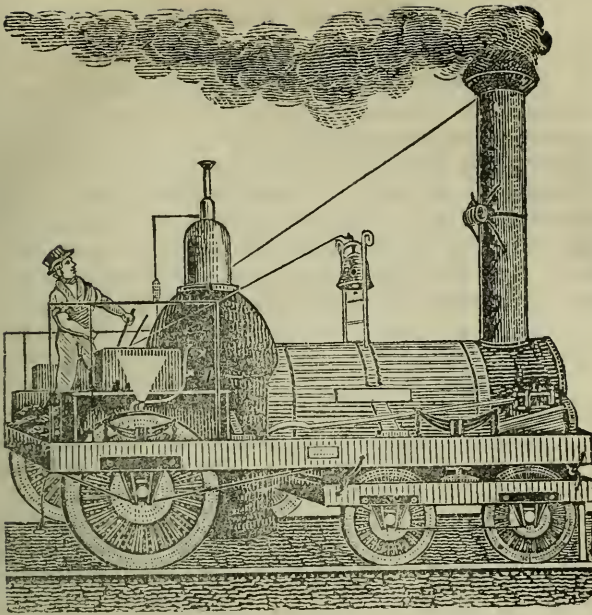


Fig. 1.

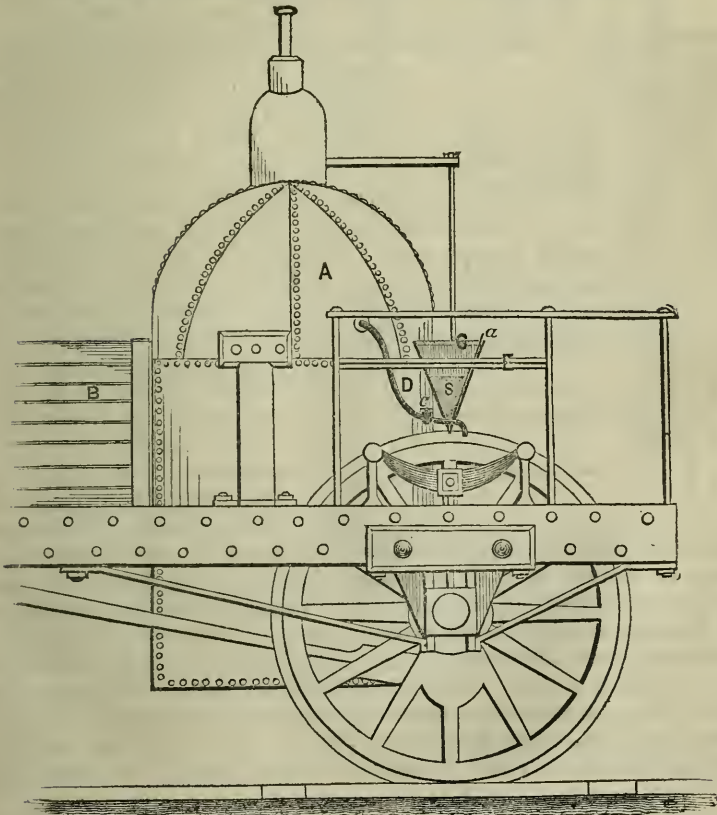
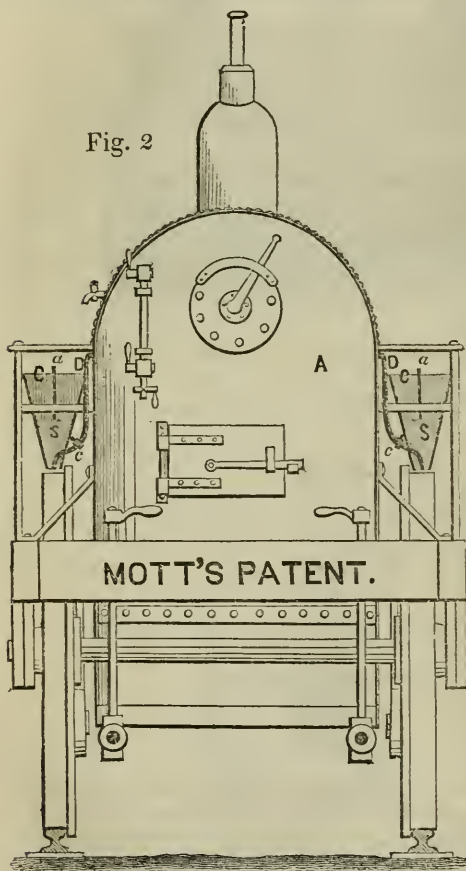


Fig. 3.

tributed over the surface of the tire, or tread of the wheels, and will be made to adhere with sufficient force, and in sufficient quantity, to produce the required adhesion. In the accompanying drawings, fig. 1, is a perspective representation of a locomotive steam engine and carriage, having two driving, and four truck wheels, to the former of which my apparatus is applied; its application, however, is not limited to locomotives of any particular construction, but is equally adapted to those with four, six, or eight driving wheels; fig. 2 is an end view, and fig. 3 a side view, of such part of a locomotive as is requisite to show the manner of applying my apparatus. A, is the steam

Fig. 2



chamber, and B, the body of the boiler, which may be constructed in any of the ordinary forms; c, c, are hoppers, or boxes, for containing sand, the lower portions, s, of which boxes are to be charged with this material in a dry state. These hoppers may be varied in situation, but I, in general, place them directly over the centres of the driving wheels; the sand is to be discharged from them through a tube, or opening, at their lower ends, which opening is governed by a valve, or sliding shutter, by which it can be properly regulated; a, represents the handle of such a valve, or sliding shutter, which may be constructed and managed in any of the known ways of constructing and managing devices of this kind; D, D, are steam, or water pipes, which are to convey the moisture to the wheel from the steam chamber, boiler, or other source. These pipes

are to be governed by a stop cock, as shown at c, c, and they discharge the water, or steam, on to the periphery of the wheel, and moisten it directly in advance of the aperture for the discharge of sand; if steam is used, it will be condensed upon the wheel, but it will probably be found to economize heat by using water. The quantity expended in either case will not, however, be important in amount. Instead of using the water, or steam, from the boiler, water may be conducted through the pipes from a cistern, or reservoir, of cold water, placed in any convenient situation for

that purpose. Although I prefer to discharge the sand and moisture upon the wheels, it will be manifest that they may be directed with like effect on to the rails in advance of the driving wheels, and that the combined operation of the moisture and sand will be the same, but the apparatus will, in this case, have to be extended, without producing a corresponding advantage.

Having thus fully described the nature of my invention, and shown how the same may be carried into operation, what I claim as new, and desire to secure by letters patent, is the applying of sand to the peripheries of the driving wheels of locomotive engines, in combination with the application of water, or steam, to moisten the wheels, for the purpose of causing the sand to adhere thereto, substantially in the manner set forth, and so as to enable such locomotives to ascend inclined planes, or elevations, on a railroad, in consequence of the friction produced by such application; I claim also the applying of moisture and sand simultaneously to the tops of the rails in advance of the driving wheels, considering this mode of applying the moisture and sand as a mere modification of the general principle upon which the utility of my invention is dependent.

JORDAN L. MOTT.

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## Practical & Theoretical Mechanics & Chemistry.

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*Memoir on the Preservation of Timber.* By M. A. BOUCHERIE, M. D.

[CONTINUED FROM PAGE 286.]

### *Is the Penetration always complete?*

In the white woods we find a central tube of variable diameter, which resists impregnation; in the hard wood, it is the most central part of the heart which remains in its natural state. This fact is worthy of attention, and appears to me, fruitful in results, both in regard to practical applications, and to physiology.

In the white woods, this central part is known to those who work in wood, as presenting the least resistance, and being the most easily decayed. It does not become impregnated, because it has no longer a circulation, or life; it is dead wood, placed in the midst of wood perfectly alive.

Many observations confirm this view of the subject, which may lead us to learn more accurately the qualities of wood. Thus I have found that this non-impregnation appears elsewhere than at the centres of the stems. It is found disseminated in all possible forms, and to a variable extent, in different parts of the same stem. Alongside of a band, the fibres of which are perfectly impregnated, will be found another band, whose fibres are not affected, and this occurrence is very often repeated in the same stem. What is the cause of this? A little attention will suffice actually to show it to us in the greater number of cases, and to deduce it by reasoning when it is not evident.

These accidents are always due to some obstacle in the circulation, and almost always, at the base of the bundles not impregnated, we



will find a knot, or a decay. No movement can then be produced during the life of these parts of the stem, and it is not astonishing that we cannot succeed in impregnating them after the tree is cut. It is, I repeat, dead wood, which must be destroyed more rapidly than the wood around it, since it has been for a long time subject to the influences which destroy all organic substances. I am aware of the boldness of such an opinion, but I also see how curious will be the experiments made to confirm, or destroy, it. I call attention to it.

This irregularity of the penetration gives rise to very remarkable peculiarities; I have pieces of wood which owe to it the appearance of marble.\*

As to the non-penetration of the most central parts of the heart of oak, elm, &c., I consider it also as a proof that the circulatory movement has for a long time ceased there; it is again, dead matter, placed in the midst of wood full of life. A number of persons will contradict this proposition, for the heart of oak is generally considered as the part of the wood which presents the greatest resistance.

In order to answer this objection, I will make one remark, and quote a single fact.

The fact, I owe to M. Emery, *ingenieur en chef des ponts et chaussées*, he informs me that in a structure of oak wood, he observed that all the pieces, in other respects sound, or nearly so, upon their exterior, were completely worm-eaten in their central parts, and that this alteration always occurred in oak wood under the same circumstances.

The remark is as follows; in the ordinary distinction which we draw between the sap wood and heart of oak, we ground it upon the difference of colour, which is presented by a section perpendicular to the axis. All that is white, or nearly so, is sap wood; all that is dark, is heart wood. Admitting the distinction, and drawing it in the same way, there is no doubt but that the sap wood is far more alterable than the heart; but the difference is not the same when we ground it upon the fact of penetration, and consider as sap wood all that is impregnated, and as heart, all which resists. The sap wood then approaches much nearer to the centre, and constitutes three-fourths of the mass of the wood.† And it may well be the penetrable substance alone, in which the circulatory movement existed, which presents this resistance to alteration; it is probably for want of careful observations that it has been admitted that the central part of the heart possesses properties which do not exist in the intermediate and living parts which are interposed between the heart and the sap wood. In

\* This central portion, this heart of white woods, varies according to age, in regard to the volume of the tree which it occupies. In trees of great age, it is larger in proportion, than in those more young. I experimented upon a pine tree eighty-five years old, in which it represented one-fifth of the cube of the wood.

† All hard woods do not resemble each other, in regard to the volume of impenetrable heart wood, as compared with the parts which it is possible to impregnate. Thus, in sea-side oaks, experiment has proved that we may succeed in penetrating three-fourths of the mass. I have found other oaks, growing on the same soil, of which not more than one-tenth could be impregnated. The season in which they were cut, it is true, was not the same, but I have not yet been able to determine whether the season was the only cause of the differences.

this case also, in order to form a definite opinion, we must have recourse to new experiments.

I will close this enumeration of all the most remarkable facts connected with the penetration of wood, by quoting an experiment originating in this course of study; it appears to me to contain excellent elements for the determination of the proper season for cutting wood, for the purpose of preserving it.

It is known that this cutting always takes place in winter; the recommendation to cut wood at this season is founded upon the false idea that trees cut in winter contain less juice than those cut in other seasons. This practice has continued for ages, and nothing indicates a disposition to abandon it; yet I believe it to be essentially pernicious to the preservation of wood, and I think that cutting them in summer, or better still, in autumn, would be infinitely preferable. The following is the experiment, which justifies the boldness of this opinion.

If after having cut a branch, or a small tree, we adapt to its extremity an U shaped tube, having long limbs, and one-fifth filled with water, we will remark a strong sucking action exercised upon the air interposed between the bottom of the branch and the surface of the water. This surface slowly rises, and finally attains a great height, at which it remains stationary when the force of aspiration is exhausted. I have found, to my great astonishment, that the volume of air absorbed is nearly equal to the cubic capacity of the branch itself, when the small twigs had been trimmed off.

This experiment appears to me to speak for itself; a great quantity of air evidently goes to replace the water which escapes from the leaves. Hence I conclude that if the cutting took place in a season when the sap is in movement, and if, contrary to the usual practice, the tree were not deprived of its foliage, this natural and abundant introduction of dry air into the sap vessels, would hasten the action of drying in an extraordinary degree.

#### *Upon Hardness.*

I will finish my remarks upon the employment of pyrolignite of iron, by mentioning that it not only insures the preservation of timber, but that its presence adds to its density, and seems to exercise a peculiar action upon the ligneous fibre. It hardens it to such a degree that the wood, when prepared, presents to cutting instruments, or any other mechanical force, a resistance at least double that of its natural state. Every workman to whom I have given wood of this kind to work has confirmed this observation, (which, I think, is of importance,) by their reiterated complaints of the difficulty of working it.

#### *Of the Flexibility and Elasticity of Wood.*

After having completed my researches upon the preservation of timber, I turned my attention to its flexibility and elasticity.

These qualities are particularly sought for in naval constructions; the woods which possess them and which preserve them for the longest time, offer such guarantees of durability and service, that the ship-

builder does not hesitate to pay, for masts of northern fir, five times as much as they would cost if made from our Pyrenean firs, or the pines of our *landes*. If, leaving this important application, we examine the circle of the arts which employ wood, we shall find, almost at every step, the necessity of this flexibility and elasticity, which timber looses more and more as it dries.

I therefore sought the means of developing these qualities, in all degrees, in timber without impairing its strength, so that, independently of those conditions of external moisture which preserve them, they might remain without being subject to any of those influences which cause their disappearance.

Nothing but the study of the causes which produce these excellent qualities, could conduct me to the knowledge of those substances, the introduction of which into the vessels of the wood, would either maintain them or communicate them artificially. I therefore proceeded in this natural way, and confirming every observation by farther experiment, I was led to perceive—

First—that the flexibility and elasticity of wood are generally proportional to the moisture which it retains, that these qualities remain only so long as this moisture continues, so that they may serve to prove its presence, even in the driest wood, and after long service.

Secondly.—That in numerous exceptions to this rule, they appear to depend upon the organic constitution of the wood.

Thirdly.—That in certain circumstances we may attribute them probably to the composition of the wood with reference to the alkaline salts which it contains.

I have purposely neglected to enter into any scientific explanations for the purpose of justifying my opinions, which, although confirmed by numerous observations and experiments, yet require further confirmation. I am now pursuing these researches on a large scale by experiments which will require time.

I confine myself at present to the consideration of the flexibility and elasticity of wood, in reference to its relation to the moisture which it contains, and I will now point out the means to which I had recourse not only to preserve these qualities but also to augment them to a degree which was truly extraordinary. To obtain this result, it is only necessary to introduce into the wood, by means of its vital absorption, a deliquescent salt, which acts not only as an agent for the preservation of its moisture, but which seems, in addition, to produce the effect of the oily bodies, developing in the wood a degree of pliability, which it by no means exhibits when first cut.

In my first attempts I used the chloride of calcium; (muriate of lime.) This compound is cheap, and I proposed to use it in all cases; but reflecting that a great consumption would perhaps augment the price beyond a reasonable limit, I endeavoured to find a substance still less costly, and was fortunate enough to think of the mother-waters of salt marshes, a product now thrown away, which may hereafter be collected and applied to this purpose—and with another view, which I shall point out. These mother-waters are essentially composed of



deliquescent chlorides, and their production is, we may say, unlimited; they gave me the same results as the chloride of calcium.

Moreover whatever deliquescent salt we may choose, it gives flexibility and elasticity to the wood, to any degree which may be desirable. The effect is but slightly remarked with very dilute solutions, while concentrated solutions render these properties excessive. In one word these qualities are developed in proportion to the state of saturation of the liquids which we employ.

My experiments were chiefly made upon pine, which is perhaps the most brittle of woods. I saturated it with concentrated solutions, and then had it cut into very thin slips.

A slip one-tenth of an inch in thickness, and two feet in length may, without breaking, be twisted in the direction of its length, so as to form a complete helix, or may be made to describe three entire concentric circles. They return immediately to a straight line, when the force ceases to act—after having been prepared for eighteen months these properties had not diminished.

Every thing leads me to believe that these saline solutions will also insure the preservation of the wood; but for greater security I mix with them one-fifth of the pyrolignite of iron.

It was to be feared that paint or varnish could not be applied in a permanent way upon wood thus prepared, but I have convinced myself that they adhere to it with as much force as to ordinary timber.

Circumstances did not permit me to study completely and upon large timber, the comparative resistance of wood thus prepared, but the orders of the ministers of the navy and of public works, are about to furnish me with the means of commencing a series of experiments on a grand scale upon this subject. I am already prepared to assert that when in masses one and a half inches square these timbers are never completely dried under the most intense heat of the sun, not even after months of exposure; the little moisture which they lose during the day, is restored to them at night, and consequently their drying never exceeds certain limits. This fact is interesting, in relation to mast-timbers which in certain latitudes are exposed to a drying which facilitates their breaking.

I will not now dwell upon the assistance which various arts may derive from this discovery, as I wish at present to insist only upon the leading fact of intervascular penetration, and upon the general results which flow from it.\*

[TO BE CONTINUED.]

\* I cannot refrain from citing a fact, which seems to me to demonstrate that the liquids introduced by the vital absorption, are really enclosed in the interior of vessels, the impermeable walls of which retain them imprisoned, even after the death of the vegetable. Having abandoned to themselves some leaves of the Sycamore, fully developed, and penetrated by strong solutions of chloride of calcium, I was not a little surprised to find that during more than two months, in proportion as the contact of the air with their surface contracted their tissue, and thus tended to diminish the capacity of their vessels, they discharged by their *foot stalks alone* a portion of the matter introduced—if the vessels had been permeable, the liquid, without doubt, instead of following so long a course, would have flowed out at the point where the contraction took place. Leaves less far advanced in their development, the vascular tissue of which, consequently, did not present the same resistance, discharged themselves under the same circumstances, by all the points of their surface.

I will mention, also, that after impregnation with chloride of calcium, these leaves shewed,

## Progress of Physical Science.

*Deductions from Observations made, and Facts collected on the path of the Brunswick Spout of June 19th, 1835. By JAMES P. ESRY, Member of the American Philosophical Society. Read April 15th, 1836.*

[CONTINUED FROM PAGE 280.]

From the evidence which I collected during five days which I spent on the Brunswick spout, the following important facts are clearly established.

The spout was suddenly formed about seven and a half miles west of New Brunswick, and terminated as suddenly at Amboy, about seventeen and a half miles from where it began. It traveled a little east of north with a very moderate velocity, probably not more than twenty-five or thirty miles an hour. It appeared to all persons, in whatever direction it was viewed, in the shape of an inverted cone of very dark cloud, or smoke, reaching from a dark cloud above down to the earth.

It prostrated nearly every thing in its path, which was from two hundred to four hundred yards wide; the trees on the north of the central line being thrown with their tops towards the south east, and those on the south of this line with their tops towards the north-east; while those in the central line itself were thrown nearly towards the east, or in the direction of the spout: not one instance being found of the trees being thrown with their tops outwards.

It unroofed the houses, prostrating many of their walls outwards as if by explosion, and tearing up the floors of some whose walls were left standing; and not unfrequently, it lifted frame buildings entire from their foundations.

It carried the joists and rafters, in some instances, to a considerable height, and threw them down on the north side of its path, four hundred yards from the house from which they were taken, almost at right angles to its course, and exactly opposite to the course which the wind must have blown at the ground in the yard, as manifested by the direction in which the trees were lying.

It carried up shingles, boards, hats, books, and branches and leaves of trees, and threw them down on the north side of the spout in a band of several miles wide, terminating on the north east end of Staten Island and fifteen miles from Amboy, where the spout ceased to reach the earth, and twenty-five miles from New Brunswick.

At the time when these materials fell, there fell with them a violent shower of hail and rain, the hail, however, being confined to a few miles in the middle of the band where the heaviest part of the shingles and boards fell.

On each side of this band, particularly on the north, there fell a copious shower of rain, mingled with shingles; and even beyond the

eighteen months after preparation, a strength at least equal to that which they had when upon the tree. This tends to shew that the presence of chloride of calcium does not in any way diminish the strength of the vegetable tissues.

borders of the rain, on the north east, small branches and leaves of trees fell in New York Bay, and in North River, opposite to the city of New York.

There was no rain nor hail on the path of the spout, nor on the south side of it; it began about a mile on the north side, increasing in quantity to the middle of the band where the hail was, and then gradually diminishing again as it approached the northern and eastern boundary.

The spout lasted only for a few seconds in a place, and was immediately before, and after, nearly calm, and its effects were hardly felt a few hundred yards off to either side. The noise which accompanied it was every where described as very alarming, not like any thing heard before, more like the rumbling of a great many carriages than any thing else, or, as one man expressed himself, like an earthquake in the air. In Staten Island, as to the length of time this noise was heard previous to the commencement of the hail and rain, the evidence varies from fifteen minutes to an hour, and as to the length of time the shower was falling, it varies from eight minutes to thirty or forty.

Though there was no rain in the path of the spout, the cloud, or mist, of which it was composed, must have been very humid, as the grave stones at Piscataway were covered on the west side with a coat of mud, and in many places the grass and leaves which lodged in masses on the west side of trees which were left standing were clotted together with mud, as if they had been drifted there by an inundation, and several persons that were caught in the spout were entirely covered with mud, so that they could not be known by their friends. There were some lightning and thunder attending the meteor, but not much unless the continual rumbling, or roar, was produced by it, which is not very likely, as a great many who heard the rumbling did not even see lightning.

The wind, probably in the whole length of the spout, certainly in many places, began to blow on the northern half of the spout from the N. E., and on the southern half of the spout from the S. E.; for materials were found which had been moved in that direction first, and afterwards carried back even beyond their original position by the hinder part of the spout, which appears, in all cases, to have been the strongest. As a proof of this, several places were found where the weak and rotten trees were thrown down by the van of the spout, with the tops of those on the northern side towards the S. W., and the tops of those on the southern side towards the N. W.; while the stronger trees which resisted the first shock were afterwards prostrated by the rear of the spout. And in every case where trees were found lying across each other, which, to a careless observer, might have indicated a whirlwind of confusion, the most perfect regularity was manifested; the strongest trees lying on top, and with their tops pointing inwards and forwards, as mentioned before.

Besides, four different places were found where the tops of all the trees in a circular space, equal in diameter to the breadth of the spout, were thrown inwards towards one common centre. In the middle of one of these stood a large frame house, which had its roof carried



off. The walls of the upper story, both on the north and south side, were cracked; and in one crack was thrust a lady's pocket handkerchief, and in the other a sheet, taken up from a bed in the room, and the cracks closed when they were carried partly through. All the windows in the house were broken, and much of the glass was lying on the outside of the house. The owner of the house is sure all this was done in a second or two of time, and he assured me that the next moment it was as still as death, not enough of air to move the leaves of the trees, which were prostrated all round his house, with their tops against his very door.

In this case the van of the spout appears to have been as strong as the rear, for several out-houses to the east of the dwelling mansion were prostrated, having many of their heaviest materials carried some distance towards the west. Perhaps indeed I was too hasty in drawing the conclusion that the rear of the spout was stronger than the van, from the circumstance that the trees were generally thrown down in the direction of the spout; for if the forces had been *equal*, they might have generally fallen in this direction, from the momentum they would have in this direction in straightening themselves, by their elasticity, at the moment the van passed and the rear came upon them. Notwithstanding, as the wind on that day was from the S. W., this circumstance renders it probable that the rear of the spout was the strongest; for it would appear that the force of the wind, whatever it was, should be added to the rear and subducted from the van.

During the fall of the rain and hail in Staten Island, the wind in the borders of the shower blew in all places from the centre of the shower, very strong in the northern part from the south, variable in the middle, and moderate in the south from the north. And the rumbling noise preceded the fall of the rain at least fifteen minutes at Mussero's ferry, on the very north side of the island. As the time of the shower at this place was certainly, from the evidence, after the spout had disappeared, it seems probable that the spout continued in mid air some time after its disappearance at the surface of the earth.

Was this noise caused by the concussion of the materials, the lighter particles of hail which were then just formed being carried up with great swiftness against the heavier, which at that time might be at their greatest elevation or even beginning to descend; or was it produced by electricity? The height of the spout where it lost itself in the cloud, though it probably rose much higher into the cloud itself, was not very certainly made out.

It is probable, however, from comparing several accounts of the distance at which it was seen, and the angular elevation as near as could be ascertained, that the height was about a mile, or, from the very distinct testimony of Mr. Cole, a little more.

He was standing four and a half miles east of Amboy, beyond which the spout did not reach. He saw a very black column of cloud, about eight times as high as it was broad, rising in the west; lighter clouds on each side of it were "streaming" towards it with great velocity and joining it, but not crossing it. The upper end of

this column was about ten degrees high. The evidence of Mr. Hunt, engineer of the boat Napoleon, is almost exactly similar to Mr. Cole's. He was about seven miles from New Brunswick, and saw the spout before it reached the town. He thinks, however, that the column was only about three times as high as it was broad. After looking at it some minutes, he could plainly see detached pieces of cloud darting inwards and upwards, joining the upper end of the column and losing themselves there, and in five or six minutes more, when the column reached New Brunswick, the materials which had been seen to fly upwards increased in number, and gave the appearance of a volcano; these materials seemed to him to rise three hundred yards. Now as the spout, when first seen by Mr. Hunt, must have been eight or nine miles distant, its height could hardly have been less than a mile.

On this same day three other spouts occurred, about seventeen miles apart, measuring perpendicular to the line of direction of the Brunswick spout. The one next to the Brunswick spout, seventeen miles north, passed through a village in the neighbourhood of Paterson, New Jersey, about three hours after the passage of the spout at Brunswick. It was accompanied by violent hail and rain on the very path of the spout.

On the same day, and afternoon, and night, there was a very great rain in the state of New York, commencing at Schenectady, about three, P. M., with a roaring, of fifteen minutes, like a distant cataract: 2.45 inches of rain fell in Albany, wind N., and much more at Lebanon. And during the whole night of the 19th, there was in the neighbourhood of Amboy a violent S. W. wind and very black clouds coming from the N. E., mingled with a bright silvery light, and most vivid lightning without thunder. The wind below changed about daylight to the N. E., and blew violently very cold for some hours, and then again resumed its old course, S. W., on the afternoon of the 20th.

On this same morning, the 20th, a most violent N. E. gale was experienced at Quebec.

Two conclusions, which promise to be of immense value in meteorology, are clearly deducible from the facts here established.

1. *There was an inward motion of the air in all directions towards the centre of the spout below, and upward motion in the middle.\**

2. *The hail was formed by the congelation of drops of rain generated at and over the place where the shingles were taken up.*

Trans. Amer. Philos. Soc.

\* The cause of this upward motion in the spout is the great expansion of the air from the evolution of latent caloric, when the vapour in the spout changes to water; the expansion of the air by the liberated caloric being about six times greater than when combined with water in the form of vapour, as has been fully explained in a paper now preparing for insertion in the Transactions of this Society.







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**JOURNAL**  
OF  
**THE FRANKLIN INSTITUTE**  
OF THE  
**State of Pennsylvania,**  
AND  
**MECHANICS' REGISTER.**

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DECEMBER, 1841.

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**Civil Engineering.**

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*Description of the Bear Trap Sluice Gates of the Lehigh Descending Navigation. By ELLWOOD MORRIS, Civil Engineer.*

The public are indebted to the inventive genius of Josiah White, Esq., President of the Lehigh Coal and Navigation Company, for the admirable hydrostatic contrivance which has received the singular name of *Bear Trap*.\*

These sluice gates were devised under the following circumstances: in the year 1818, Messrs. White, Hauto, Hazard, and others, associated themselves under the style of the "*Lehigh Navigation Company*," for the purpose of improving the Lehigh river by means of wing-dams, &c., so as to form a descending navigation suitable for the transportation of coal from the Anthracite mines, near Mauch Chunk, to the city of Philadelphia.

This work was commenced upon the 10th of August, 1818, as appears by the "History of the Lehigh Coal and Navigation Company, published by order of the board of managers in 1840," and did not originally contemplate the use of sluice gates as a primary expedient; the residents upon the margin of the Lehigh river having pointed out "a certain mark in a rock at the Lausanne landing," as the low-water level of the stream, Messrs. White & Co. were induced to

\* The writer is indebted to Josiah White and Erskine Hazard, Esqs., for the opportunity of examining the drawings in the office of the Lehigh Company, and for the personal explanations which have enabled him to draw up, for the Journal of the Franklin Institute, the present account of the Bear Trap Sluice Gate.

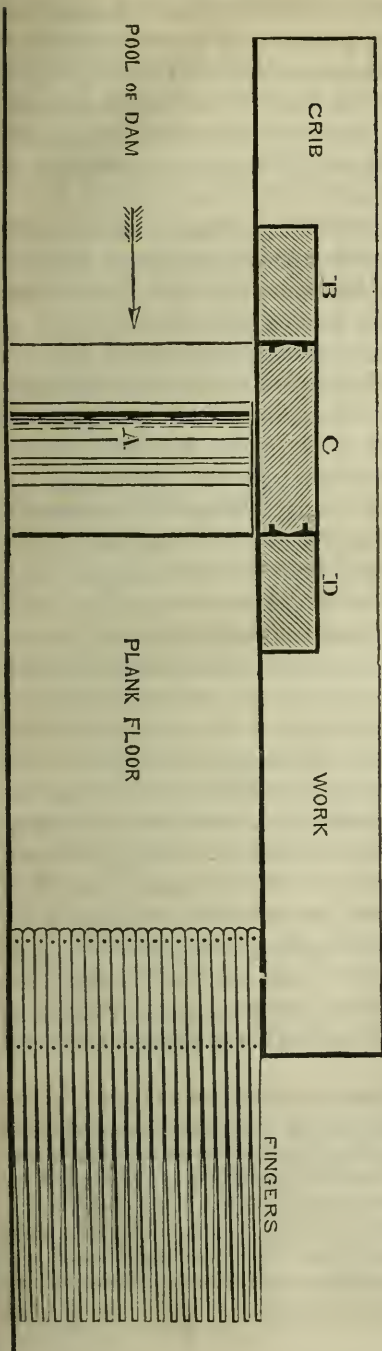
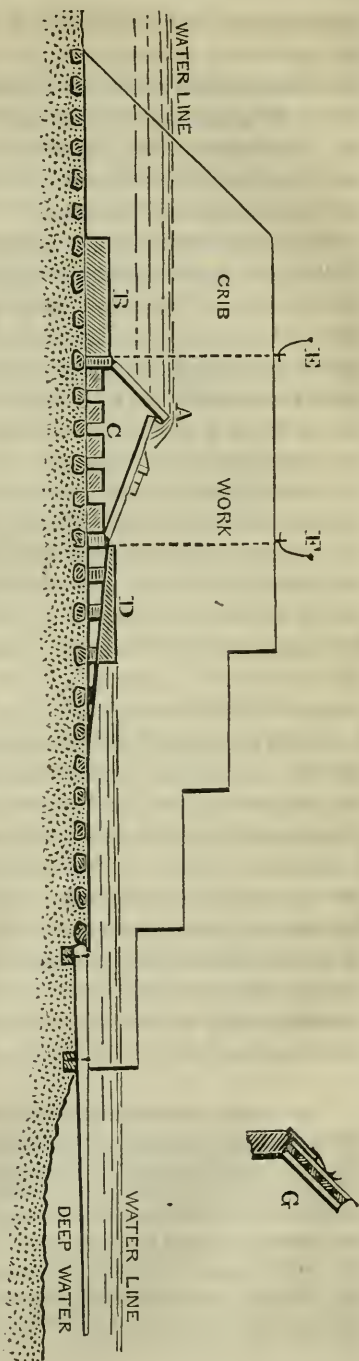


believe that there would always be a sufficiency of water for their purposes, if it were "confined by wing-dams in its passage over the ripples, or shoals, from pool to pool," and under this impression the work was begun; but in the autumn of 1818 "the water in the river fell by an unparalleled drought, as was believed, fully twelve inches below the mark which has been mentioned as shown by the inhabitants to be the lowest point to which the river ever sunk. Here was a difficulty totally unanticipated, *and one which required a very essential alteration in the plan.* Nature did not furnish enough water by the regular flow of the river, to keep the channels at the proper depth, owing to the very great fall in the river and the consequent rapidity of its motion. It became necessary to accumulate water *by artificial means*, and to let it off at stated periods, and let the boats pass down with the long wave thus formed, which filled up the channels. This was effected by constructing dams in the neighbourhood of Mauch Chunk, in which were placed sluice gates of a peculiar construction, *invented for the purpose* by Josiah White, one of the managers, by means of which the water could be retained in the pool above, until required for use. When the dam became full, and the water had run over it long enough for the river below the dam to acquire the depth of the ordinary flow of the river, the sluice gates were let down, and the boats, which were lying in the pools above, passed down with the artificial flood."

It was to meet the exigency created by the discovery above mentioned, that Mr. White contrived the beautiful sluice gate, which we are about to describe, and upon the successful operation of which, the whole enterprise very much depended.

At that day the scene of the company's operations was almost a perfect wilderness, and the carpenters having been set at work to frame a sluice gate for trial, it became an object of great curiosity to the settlers; who being far more familiar with the implements used in the chase and capture of the beasts of the forest, than with the hydraulic works of a flash navigation, either in jest, or from some fancied resemblance of the sluice gate to a *Bear Trap*, quickly gave to it this cognomen, which it ever since has borne.

The *Bear Trap Sluice Gate*, which is exhibited in plan and section in the annexed diagrams, consists of two leaves or shutters, reclining against each other so as to present a triangular vertical section, and contain beneath them a space capable of being filled with water from the superior level and emptied thereof at will; the contained angle at the vertex when the gates are up being rather more than  $100^\circ$ , in order that the leaves may slide easily, one over the other, which they evidently would not do if the vertical angle of the uplifted gate were



either a right or an acute angle; this sluice gate is raised and depressed by hydrostatic pressure, applied and removed upon the principle of that well known philosophical instrument called the Hydrostatic Bellows; in its usual form, as applied upon the Lehigh, *it will not work in dead water*, but requires the action of a head more than sufficient to overcome the weight and friction of the gates, to enable it to be manœuvred with facility.\*

By an inspection of the diagrams it will be perceived that the leaves of the gate are hinged horizontally with hollow quoin joints, at some distance above the floor; the hinge of the upper leaf being higher than that of the lower, by something more than its thickness, so that even when the gate is down there is a vacant space into which the aperture opens from the well C, because the height of the hinge of the lower leaf is fixed at about the same level as the tops of the openings communicating with the well.

Catch blocks on the underside of the upper leaf determine the height to which the rise of the gate is limited; the well C is constantly in communication with the vacancy beneath the gate; the water chamber B, is constantly open to the water from the upper level, whilst that of the lower level flows freely into the chamber D; it will be observed that both these chambers communicate by suitable wickets with the well C; now it will be evident from inspection that if the wickets F, between C and D are shut, whilst the wickets E between C and B are opened, the water from the upper level will enter beneath the leaves with the *upward* hydrostatic pressure due to the head, and the gate will consequently rise; now on the other hand if the wickets E are closed, whilst those at F are opened, the *downward and lateral* hydrostatic pressure of the water in the upper level, acting then upon the top surface of the upper leaf, will force down the gate; and thus by simply putting the vacancy beneath the leaves of the sluice gate, in communication *separately* with the upper and lower levels *alternately*, the gate is elevated, depressed, or arrested at any stage of its movement, by hydrostatic pressure alone; the only manual labour or attention needed for the highest and widest gates, being that which

\* Mr. English, formerly a contractor upon some of the works of the Lehigh navigation, having for many years observed the action of the Bear Trap Sluice Gates, has conceived the idea of rendering them applicable as the upper gates of *Lift Locks*, by placing a large air vessel under the lower leaf, which by its buoyancy enables the gates to rise in dead water: and he has exhibited at the Franklin Institute a working model of a lock having the Bear Trap Gates with his attached air vessel applied as *upper gates*; and, though liable to some objections there is reason to believe that for the upper, if not for both, gates of *Lift Locks* only, they will prove to be a valuable improvement, though it is evident that the same object may be attained; by the application of counter weights, but not perhaps as well as by an air vessel.



is requisite to manœuvre the wickets E or F, a duty for which a mere boy would be physically competent.

The sluice gates used upon the Lehigh descending navigation, as there is no necessity of making them perfectly water tight, are allowed a play on each side of half an inch or more, which effectually prevents lateral friction; they are generally twenty-four feet wide, formed by spiking together three successive layers of thick plank, and the lower leaf is strengthened by bolting upon its back a few heavy beams, (as may be seen in the sketch annexed,) which rest their extremities against suitable stops when the gate is up.

Where the water, violently descending the sluice, leaves the platform, it usually excavates the bed of the stream and forms deep water, the sudden entrance into which, of boats shooting down the sluice, would prove very injurious to, or even destroy, them, if it were not for the ingenious device called *fingers*; these consist of the trunks of trees placed side by side, and bolted to heavy subsills, with their butts up-stream, the tops freely projecting over the lower sill some twenty feet or more; they receive in part the shock of the boat in its plunge into the deep water, and by their elasticity ease off its momentum so that it glides down with the swift stream uninjured; this dexterous mode of avoiding concussion, is found in practice fully to answer the end for which it was designed.

For the purpose of guarding the horizontal hinges of the leaves of the sluice gates against obstruction from the deposition of gravel, a glove of plank is ingeniously secured across the hinge by a curved spring, as shown at G, and in contact with this plank glove, the leaf revolves upon its hinges, without the possibility of being impaired in its action by the lodgment of hard substances.

From the above description and the annexed sketches, which are designed more to develop *the principle* of the sluice gate, than to display all the details of its construction, it is hoped that the plan and mode of action of the *Bear Trap Sluice* may be gathered without further explanation, and we will now proceed to make a few remarks upon the great usefulness of this invention.

#### *Utility of the Bear Trap Sluice.*

This skilfully devised hydraulic machine, continued in use upon the lower Lehigh—giving perfect satisfaction in practice—from the year 1821 until 1829, when the descending navigation upon the main part of the river, was abandoned for an improvement which admitted of transit in both directions: though a section upon the former plan, with its Bear Trap Sluices, still forms the navigation for the lumber trade between Whitehaven and Stoddartsville, a distance of twelve and one

fourth miles, in which by wing-dams, channels, and sluices, a fall of three hundred and thirty-six feet is overcome.

The causes which led to the substitution of a slackwater, for a flash navigation, and the difficulties met and surmounted by the ingenious and energetic individuals, who directed the works of the Lehigh company, are so interesting that we will make a digression to quote a few more passages from the company's published "History."\*

"The boats used upon the Lehigh descending navigation consisted of square boxes, or arks, from sixteen to eighteen feet wide, and twenty to twenty-five feet long. At first two of these were joined together by hinges, to allow them to bend up and down in passing the dams and sluices, and as the men became accustomed to the work, and the channels were strengthened and improved as experience dictated, the number of sections in each boat was increased, till at last their whole length reached one hundred and eighty feet. They were steered with long oars like a raft. Machinery was devised for jointing and putting together the planks of which these boats were made, and the hands became so expert that *five men would put one of the sections together and launch it in forty-five minutes*. Boats of this description were used on the Lehigh till the end of the year 1831, when the Delaware division of the Pennsylvania Canal was partially finished. In the last year, forty thousand nine hundred and sixty-six tons were sent down, which required so many boats to be built, that, if they had all been joined in one length, they would have extended more than *thirteen miles*. These boats made but one trip, and were then broken up in the city, and the planks sold for lumber, the spikes, hinges, and other iron work being returned to Mauch Chunk by land, a distance of eighty miles.

"The great consumption of lumber for the boats very soon made it evident that the coal business could not be carried on, even on a small scale, without a communication by water with the pine forests, about sixteen miles above Mauch Chunk, on the upper section of the Lehigh. To obtain this was very difficult. The river in that distance, had a fall of about three hundred feet, over a very rough, rocky bed, with

\* In the published history from which we quote, the opinion is advanced, that "the descending navigation by artificial freshets on the Lehigh, is the first on record as a permanent thing."

This, however, is a mistake, for the system of rendering shallow streams navigable by the mode called *Flashing*, which is "to create an artificial flood for a time by penning up the water in the river itself," and then opening the sluice or flood-gates, when the boats are passing, is supposed to have been invented by the Egyptians after the time of Alexander, and was found in use in the hydraulic works of the interior of China, when that empire was visited by the first English embassy.

See New Edinburgh Encyclop. Art. Nav. Inland.

shores so forbidding that in only two places above Lausanne had horses been got down to the river. To improve the navigation it became necessary to commence operations at the upper end, and to cart all the tools and provisions by a circuitous and rough road through the wilderness, and then build a boat for each load to be sent down to the place where the hands were at work, by the channels which they had previously prepared. Before these channels were effected, an attempt was made to send down planks, singly, from the pine swamps, but they became bruised and broken by the rocks before they reached Mauch Chunk. Single saw-logs were then tried, and men sent down to clear them from the rocks as they became fast. But it frequently happened that when they got near Mauch Chunk, a sudden rise would sweep them off, and they were lost.

"It became evident that the business on the Lehigh could not be extended as fast as the demand for coal increased, while it was necessary to build a new boat for each load of coal; besides the forests were now beginning to feel the waste of timber, (more than 400 acres a year being cut off,) and showed plainly enough that they would soon disappear, in consequence of the increased demand upon them.

"Under all these circumstances, it was concluded that the time had arrived for changing the navigation of the Lehigh into a slackwater navigation. The acting managers, who resided at Mauch Chunk, formed a plan for a steamboat navigation with locks one hundred and thirty feet long and thirty feet wide, which would accommodate a steamboat carrying one hundred and fifty tons of coal. These locks were of a peculiar construction, adapted to river navigation. The gates operated upon the same principle with the sluice gates in the dams for making artificial freshets, and were raised or let down by the application or removal of a hydrostatic pressure below them. The first mile below Mauch Chunk was arranged for this kind of navigation. *The locks proved to be perfectly effective and could be filled or emptied, notwithstanding their magnitude, in three minutes, or about half the time of an ordinary lock.*"

One of the writer's objects in making the above lengthy extract, was to enable the reader to trace the causes which led to the abandonment of the flash navigation on the Lehigh, and to see that it arose from no defect in the sluice gates or other works at first erected.

It must be evident to every one that *the Bear Trap Sluice Gates*, finding as they do their operating power in the hydrostatic pressure consequent upon the difference of level which they overcome, are capable of application to almost any width of opening; and that a gate of one hundred feet or more in length could be manœuvred as readily as one of twenty-four feet, the only additional labour requisite being that of opening and closing a few more wickets.



In the descending navigation of the Lehigh, a case occurred where a fall of sixteen feet in about three hundred was overcome by one of the Bear Trap Sluices, though it was found necessary here to bolt a series of beams upon the platform, transversely across the opening, so as to moderate the velocity of the descending volume of water, by increasing its friction upon the bottom of the passage.

For the gates of the locks of a steamboat, or other large navigation,\*—for the gates of a dry dock by using the air vessel in raising; and in lowering them, a pump to extract the water from the space beneath—for all sluices where the sudden discharge of large bodies of water is required—for the waste-weirs and stop-gates of canals—and for other similar purposes, the *Bear Trap Sluice Gate* leaves nothing more to be desired, and is certainly far superior to any other contrivance for effecting the same purposes, which the writer has ever seen in practice or found described in the professional writings to which he has had access.

With gates of this sort of one hundred feet opening, having suitably prolonged chamber walls, and placed in low dams of four or five feet high, it would probably be easy to maintain throughout the year a steamboat navigation upon the upper waters of the Ohio, as the powerful steamers in use upon the western rivers, would find but little difficulty in stemming the current through such wide openings in dams of small height upon a low river, whilst in high floods they could pass up over the dams themselves, as they now do at such times over the falls at Louisville, Kentucky.

*Philadelphia, October 15th, 1841.*

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*Railways in Germany.—Railway between the Moldau and Danube.*

CONTINUED FROM PAGE 246.

The railway from Budweis, in Bohemia, to Lintz, in Upper Austria, connecting the Moldau with the Danube, and the North sea with the Black sea, claims the merit of having been the first constructed and put into operation on the continent of Europe, for the transportation of passengers and freight. It was commenced when railways had made but little progress in England, and were known in Germany only in some of the deep mines of Saxony; and although intended only for horse power, and constructed accordingly, though in many respects behind the modern improvements of this kind, a short notice of it may perhaps be welcome to those who take an interest in the history of railways.

The project for this railway originated in the proceedings of the commissioners from the ten Elbe-states, who held a convention at

\* When used for lock, or dock gates, proper stops should be placed to receive the leaves of the gate, both when up and when down, so as to avoid any loss of water in either of these positions, whilst lateral play enough is allowed to enable an easy motion in both directions.

Dresden in 1819, with the object of regulating the free navigation upon the river Elbe. Before parting they applied to the Austrian Government with the request to improve the navigation of the river Moldau to the town of Budweis, and to construct, from thence to the Danube, a canal, in order to connect the waters of the North sea with those of the Black sea. The late Chevalier de Gerstner, then professor of mathematics in Vienna, immediately put himself at the head of the undertaking, made a survey of the country, and proceeded to England, there to consult about the best plan of crossing by a railway the ridge of mountains separating the valleys of the Moldau and Danube, and which at the point of crossing is 1000 feet above the level of water in the one, and 1500 feet in the other river. Contrary to the opinion of some eminent English engineers, he adopted the plan of reaching the summit by a gradual ascent, and not to resort to inclined planes requiring stationary power. Returned from England in 1822, he proceeded to make very minute surveys, and on the 7th of September, 1824, received for his own person a privilege from his late Majesty, Francis I, for the construction and use of a railway between the Moldau and the Danube. In March, 1825, he formed a company of stockholders in Vienna, and constructed and finished the first thirty-nine miles, from Budweis to the summit, up to the end of 1828. The principles adopted in the construction of this part of the road were not to introduce any steeper gradients than forty-four feet per mile, nor any sharper curves than 622 feet radius; finally, never to lose again any ascended height. Difficulties having afterwards arisen with the Railway Company, in consequence of the excess of expenditure over the estimate, the Chevalier de Gerstner resigned his office as chief engineer, and the railway was, in the subsequent years, finished under the superintendence of his assistant, Mr. Shoenerer. The latter half of the road, however, which was put into operation on the 1st of August, 1832, has only the merit of having been executed in the cheapest possible manner; the principles of construction so judiciously adopted by the Chevalier de Gerstner were entirely abandoned; the railway here frequently loses ascended heights, has a maximum rise of 115 feet per mile, and curves of sixty feet radius, and in fact offers little advantage over a good turnpike road.

The total length of the railway, beginning in the centre of the town of Budweis, and terminating at Urfar, a suburb of Lintz on the Danube, is eighty miles; it was commenced in 1825, and finished in 1832, at an aggregate cost of £165,430 sterling, being only £2,068 per mile, with a single track, including all the necessary buildings, wagons, carriages, &c., &c. To cover these expenses, there were issued:—

|                                             |   |   |   |   |          |
|---------------------------------------------|---|---|---|---|----------|
| 3,783 shares, at £20,                       | - | - | - | - | £75,660  |
| 9,000 do. do. sold at £5 only,              | - | - | - | - | 45,000   |
| And there was made a loan at five per cent. | - | - | - | - | 40,000   |
|                                             |   |   |   |   | <hr/>    |
|                                             |   |   |   |   | £160,660 |

400 shares at £20, were given as a premium for this loan, and 1,817 shares at £20, were lately issued and sold at £11, to pay some

temporary debts, and for other purposes. 15,000 shares at £20, or £300,000, therefore, are now the capital stock of the company. Of the loan of £40,000, £1,200 are paid back annually, and there remain at present due only £28,000. The circumstance of the amount of capital stock and loan being £328,000, or just twice as large as the actual cost of the railway, must of course operate injuriously upon its dividends.

The railway from Budweis to Lintz has a single track of  $43\frac{1}{2}$  inches in width, measured between the rails; it passes through a very wild and broken country, frequently along steep side hills, on the edge of deep ravines; crossing from one valley to the other, winding its course in a thousand curves to the high summit, and then descending again in a still more circuitous route into the deep valley of the Danube. About one-half of the road is in Bohemia, the other half in Upper Austria. There are in the whole line, 965 culverts and bridges, 2,860,000 cubic yards of excavations and embankments, 376,000 cubic yards of dry walls, and 67,000 cubic yards of masonry laid in mortar. The dry walls were at first designed to support the superstructure of the railway, and erected simultaneously with the embankments to the requisite height; afterwards they were omitted, and the superstructure laid upon the surface of the earth, or gravel. It consists in cross ties of six feet in length, and six inches in diameter, flatted only on the lower side, and notched in to receive the longitudinal or bearing timbers of six by seven inches. The cross ties are laid at a distance of three feet from each other, and the longitudinal timbers are eighteen feet in length. Upon the latter, iron plate rails of nine feet in length, and two and a half by one-half inch, are fastened with square spikes of five inches in length. The timber is now delivered to the railway, ready for laying down, at one penny per foot run for the longitudinal stilts, and at five-sixths of a penny for the cross ties. The iron plate rails are got from the iron works in Bohemia, or Styria, at £13 10s. per ton; the spikes for fastening the rails at £1 7s. per cwt.

The railway is used principally for the transportation of salt and merchandise, which is carried on in summer and winter without interruption. During the better seasons passengers are also conveyed over the road, but their number is very small. Horse power is exclusively employed; a wagon weighing one ton is generally loaded with two and a quarter tons of goods, and according to the rate of ascent on different parts of the railway, one horse will draw two such loaded cars; three horses five wagons, one horse one wagon, and finally, two horses one wagon. The gross load drawn by one horse therefore varies from one and five-eighth tons to six and a half tons; the average load for the whole line being three and a quarter tons, allowing a net load of two and a quarter tons. The whole line is divided into six divisions, and there are, therefore, besides the principal stations at both ends, five intermediate ones, where the horses are changed. Three days are allowed for a freight train to pass over the whole line; it leaves the station in the morning, arrives at the next at noon, where the horses are changed, and then proceeds to the second



in the afternoon; the same horses pass from one station to the other and back the same day, and perform in this way twenty-seven miles regularly. The goods are received and forwarded by the Railway Company, who charge—

|                     |   |   |                                 |
|---------------------|---|---|---------------------------------|
| For grain and coal, | - | - | Per ton, from Budweis to Lintz. |
| Other articles,     | - | - | 7.2s. or 1.08d. per mile.       |
|                     |   |   | 9.6s. or 1.44d. per mile.       |
|                     |   |   | Per ton, from Lintz to Budweis. |
| For grain and coal, | - | - | 14.4s. or 2.16d. per mile.      |
| Other articles,     | - | - | 18s. or 2.7d. per mile.         |

The company keep the railway and buildings in good order, furnish the wagons and all men necessary for repairing the same, loading, and unloading, &c.; the motive power is let to a contractor, who finds the horses, drivers, and grooms, and receives so much per cwt. carried over the whole distance between Budweis and Lintz. The amount is in some measure proportionate to the price of oats; it was fixed last year at 6s. per ton for the whole distance, (eighty miles) or at 0.9d per ton per mile, when the price of oats was 1s. 4d. per bushel, and 2d. more were paid per ton for every penny the bushel of oats increased in price. In August, the price of oats was 1s. 8½d., and the contractor got, therefore, 6s. 9d. per ton for eighty miles, or one penny per ton per mile. The charges for motive power were always determined for one whole month, the average market price of oats for the month past having served as a basis for the calculation. The public houses attached to the stables at the five intermediate stations were erected by the company, but are left gratuitously to the contractor of motive power for the accommodation of his men.

Passengers are carried daily over the railway, (except in winter,) in two different classes of carriages; the charge for a seat in a first class carriage is 6s., in the second class, 4s., being at the rate of only 0.9d. and 0.6d. per mile. Two carriages containing each six seats inside, and as many outside, start daily in the morning from each end of the line, drawn by two, three, or four horses, as the rate of ascent requires, the horses are changed five times. Half-way, near the summit, the carriages coming in opposite directions meet, and here an hour is allowed for dinner; the whole distance is generally performed in fourteen hours, including all stoppages, and the speed is from six to six and a half miles per hour. Horses and drivers are furnished by the same individual who contracted for the transportation of freight, and he receives one-half of the revenue from passengers, after deducting the salaries of conductor, and some other incidental expenses.

The following statement exhibits the traffic and travel, and the net income of this railway from the year 1833 to 1839 inclusive.

| Year. | Quantity of<br>salt transport-<br>ed. | Quantity of<br>merch. trans-<br>ported. | Total quantity. | Wood.                   | Passen-<br>gers car-<br>ried. | Total net<br>income. |
|-------|---------------------------------------|-----------------------------------------|-----------------|-------------------------|-------------------------------|----------------------|
|       | Cwt.                                  | Cwt.                                    | Cwt.            | Fathoms<br>(120 c. ft.) |                               | £ s.                 |
| 1833  |                                       |                                         | 331,609         | 2,733                   |                               | 6,805 14             |
| 1834  |                                       |                                         | 450,444         | 2,654                   | 2,379                         | 7,582 18             |
| 1835  | 320,212                               | 194,040                                 | 514,252         | 1,862½                  | 3,887                         | 9,037 11             |
| 1836  | 352,671                               | 190,431                                 | 543,102         | 2,124                   | 3,948                         | 9,151 2              |
| 1837  | 324,251                               | 168,842                                 | 493,093         | 2,538                   | 3,887                         | 8,129 18             |
| 1838  | 345,647                               | 234,813                                 | 580,460         | 2,078                   | 5,454                         | 9,773 15             |
| 1839  | 392,388                               | 301,737                                 | 694,125         | 3,721                   | 10,479                        | 9,177 7              |

It appears, therefore, that there was a constant increase in the traffic; taking the average for the whole seven years, we have per year, 25,765 tons of goods, and 2,530 fathoms of burning wood; calculating the latter at one and a half tons per fathom, we find the annual transportation equal to 30,000 tons of goods, and 5,000 passengers; in the year 1839, there were transported 40,287 tons of goods, and 10,479 passengers.

The average net income per year amounted to £8,522 12s.; if the same be compared with the cost of the road, viz.: £165,430, it shows that the railway, from the commencement of its operations, has yielded a profit of over five per cent. on its cost; notwithstanding its most disadvantageous line and profile, the necessity of employing horse power instead of steam power, which would be much cheaper, the comparatively small traffic, and the low charges for freight and passage; a result which must be regarded as highly favourable, and encouraging for the undertaking of similar works in parts of the country less wild and mountainous, and more populous and productive.

#### *Railway from Lintz to Gmunden, in Upper Austria.*

When the first railway in Austria, from Budweis to Lintz, had been completed, in spite of the many embarrassments and difficulties which attended its progress, the company found it their interest to extend the same from Lintz to Gmunden, on the Traun-lake, which they were permitted to do under their original charter. This new railway was commenced in 1832, finished partly in 1835, and opened in its whole length in May, 1836; its principal object is to furnish the means of cheap transportation for the immense quantity of salt, which is manufactured in the vicinity of the Traun-lake, and exported principally to Lower Austria and Bohemia; passing through a very populous section of country, it also accommodates a very great local travel, and

is besides frequented by those who visit from the north, the celebrated watering place of Ischel, or the Alps in Salzburg and Tyrol.

The line of the Lintz and Gmunden Railway commences on the right bank of the Danube at Lintz, passes through several streets level with the pavement, to the outskirts of the city, in the direction of the river Traun, the course of which it then follows up to the foot of the lake of that name. The whole length is  $42\frac{1}{4}$  miles, a small branch of one and a half miles leads from the main line, near Lintz to Zitzlau on the Danube, where the goods destined for Lower Austria are transhipped directly into the boats. In general, the country through which this railway passes is more favourable, the line therefore pretty direct, and the curves are gentle. The maximum rise is fifty-three feet per mile, with the exception of a short part near Gmunden, where a rise of 240 feet per mile has been adopted. The plan of construction is the same as that of the railway from Budweis to Lintz, a single track, with turnouts; the clear width three feet seven and a half inches. The total amount expended for the construction of the road, buildings, fixtures, &c., was £71,970; the cost per mile was therefore only £1,645. The funds were raised by private loans; certificates of stock, to the amount of £65,000, bearing five per cent. interest, and redeemable after ten years, were issued by the company; and in order to get subscriptions for the same, the first subscribers were promised to receive such profits as would remain after the payment of the interest, and all the current expenses. The holders of the scrips in this manner received, besides their interest, in 1836, £1,036; in 1837, £1,917; and in 1838, £2,072. For these profits they were for the future compensated by 1036 shares of the original stock of the Budweis and Lintz Railway, so that the whole profit of both railways is now regularly divided amongst the shareholders, after the interest on the loans has been paid. In 1846, the capital borrowed, of £65,000, may be paid back at once, or at the option of the company, in twenty annuities from thence, with the interest at five per cent. on the amounts due.

The contractor of motive power on this railway receives 2s. 6d. per ton for the whole distance, ( $42\frac{1}{4}$  miles,) or 0.7d. per ton per mile, when the price of oats is 1s. 6d. per bushel, and 1d. more per ton for every 1d. the price per bushel is greater than 1s. 6d. In August, 1840, when the price of oats was 1s. 11d., the contractor received, for furnishing the motive power, 2s. 11d. per ton for the whole distance, or five-sixths of a penny per ton per mile. The same contractor also receives  $7\frac{1}{2}$ d. per passenger carried over the whole line, which is only at the rate of 0.17d. per passenger per mile. The company charges, per ton of goods of every description, 7s.  $9\frac{1}{2}$ d. for the whole distance, or 2.22d. per ton per mile.

For passengers.—1st class, 2s. 6d., or 0.71d. per mile.

Do. 2nd class, 1s. 7d., or 0.46d. per mile.

Notwithstanding these low fares, the income from this railway has, since the commencement of its operations, been very considerable, as



may be seen from the following statement of the annual traffic and net income for the years 1836 to 1839, inclusive:—

| Year. | Salt.   | Merchan-<br>dize, &c. | Total quan-<br>tity. | No. of Pas-<br>sengers. | Net in-<br>come. |
|-------|---------|-----------------------|----------------------|-------------------------|------------------|
| Cwt.  | Cwt.    | Cwt.                  | Cwt.                 |                         | £ s.             |
| 1836  | 464,492 | 143,174               | 607,666              | 74,759                  | 4,262 13         |
| 1837  | 569,232 | 144,809               | 714,041              | 77,905                  | 5,236            |
| 1838  | 601,606 | 157,687               | 759,293              | 90,353                  | 5,373 16         |
| 1839  | 652,218 | 156,106               | 808,324              | 103,713                 | 6,004 13         |

At an average there were carried upon the road annually—

Salt, - - - 28,594 tons.

Other articles, - - - 7,522 “

Total, 36,116 tons of goods, and 86,682

passengers.

The net income amounted, per year, to £5,219 5s., equal to seven and a quarter per cent. on the cost of the railway of £72,000.

Both railways are managed by the same Board of Directors; the technical department is superintended by a road commissioner, who receives a salary of £120 per year, besides £30 for traveling expenses, &c. The railway track is kept in order by workmen stationed along the line. There were fifty-two small houses built for them at a distance of one and three quarters to two and a quarter miles from each other; each is inhabited by a married man, who works with his wife, and receives 20s. per month, and some of the old timber for fuel. In each division of twelve to fourteen miles, a way-master is appointed, who superintends the workmen, and has a salary of £3 per month. About 600 wagons, and forty-five passenger carriages, are upon both railways; their repairs are conducted by a foreman, assisted by a carriage-maker, two harness-makers, and a suitable number of blacksmiths. The principal work-shops of the company are at Urfar and at Lest.

The railways here described have acquired additional importance since the opening of steam navigation upon the Danube, between Lintz and Vienna. The distance between the two cities is 144 miles. The iron steamboat *Sophia*, sixty horse power, drawing three feet water, performs the trip *down* to Vienna in nine and a half to ten hours, including stoppages. The running time is about nine hours, and the average speed, therefore, sixteen miles per hour; but it must be remarked that the river has a current of near five miles per hour, and that it requires from thirty to thirty-six hours for the same steamboat to run *up* the river to Lintz. The coal used in the steamboats upon the Danube is brought from Pilsen, in Bohemia, eighty-five miles upon a turnpike road to Budweis, and other eighty miles over the railway to Lintz. The transportation over the first costs 18s. per

ton; over the latter, only  $7\frac{1}{2}$ s., which shows clearly the advantage of a railway over a turnpike road, even in a mountainous country. At Lintz, the coal is sold at £1 16s. per ton.

TO BE CONTINUED.

## Practical & Theoretical Mechanics & Chemistry.

*Memoir on the Preservation of Timber.* By M. A. BOUCHERIE, M. D.

[CONTINUED FROM PAGE 355.]

*Of the Play of Timber, and the means of remedying it.*

Wood, when worked up, however dry it may be, expands and contracts incessantly under atmospheric influences; from this result cracks, which are the mortification of constructors, and which become serious, when the wood employed was not sufficiently seasoned.

This seasoning, which requires a long time for timbers of ordinary dimensions, is still more slow in large pieces. The consequence is, that in proportion to the mass of wood annually cut, an enormous capital thus remains inactive. These inconveniences have for a long time employed the attention of those who cut timber, and have been a subject of much study to the engineers of the Marine department.

A more rapid seasoning has been sought for, and obtained, by squaring the wood the moment that it is cut in the forests; but the loss of time is still considerable, notwithstanding their recourse to careful piling, under sheds, and upon a carefully chosen soil.

The previous immersion of the timbers in fresh and salt water has also been tried without more success.

As to the seasoning obtained by means of furnaces and drying ovens, besides the onerous expense which they require, it is admitted that wood thus dried, absorbs again from the air a portion of the water which it had lost, and soon warps like other wood.

Steam also has been used. I have not been able to obtain any accurate accounts of this process, and of its results; and still less have I been able to determine *a priori* the good effects which are to be expected from it.

The question thus remaining without answer appeared to me to be untouched, and I commenced by studying at the same time the nature and the cause of the inconveniences which I wished to remedy.

It was easily and quickly observed that the successive changes in volume which the wood underwent, were solely due to its hygrometric state, which again was completely dependent upon its porosity, and the presence in its tissue of matters which absorb water with avidity.

The best remedy against such an evil is evidently to close all the pores, and thus to prevent the air from depositing any thing in the wood, or from removing from it those minute portions of water which are the only causes of the expansions and contractions which it experiences.

In reflecting upon the means of obtaining this result, I was led to remark that the cracks did not begin to show themselves in unseason-

ed wood until an advanced period of its drying, and when it was on the point of losing the last third of the water which it contained. To preserve this in it, then, appeared to me to be an infallible means of preventing this play, which has heretofore been inevitable. I immediately proceeded to test, by experiment, the value of this idea.

All the facts confirmed my expectations. Wood kept always moist, within certain limits, by means of the penetration with a deliquescent chloride, remained unalterable in its volume, no matter to what atmospheric variation it was exposed; it changed its weight indeed, and that even in a greater proportion than wood in its natural state, but these changes produced no alteration of the form. The fibres remained in their places, the bonds which united them neither expanded nor broke, and the wood did not appear to have been subjected to any important influence.

In order to judge of the degree of protection which this process offered against the play, I caused to be constructed of prepared wood tablets of large dimensions, and of very little thickness, some of which were left as they came from the hands of the workmen, while others were painted upon their two faces.

I observed a year after they were prepared, that these tablets had remained unaltered, while others prepared in a similar way from wood in its natural state were strangely warped.

The employment of chlorides, thus advantageous in preventing the play of wood, reduces also materially the time necessary to season it. We thus economize all the time which is necessary for the evaporation of the last third of water which it contains.

This property thus preserved in wood, allows us to employ it with confidence for all kinds of furniture, and for the doors and windows of rooms, without having to fear those crevices so fatal to the best pieces of workmanship.

By introducing, mixed with the earthy chlorides, one fifth part of pyrolignite of iron, we insure preservation for an indefinite period.

*Of the means of diminishing the inflammability and combustibility of wood used in building.*

When I first satisfied myself that it was possible to preserve a certain moisture in wood by means of the earthy chlorides, I easily conceived that by means of the same substances I might not only diminish in a great degree its inflammability, but also render very difficult the combustion of its carbon, thus kept out of contact of the air by the fusion of the earthy salts at its surface, and in the mass.

These expectations were confirmed by experiment. I have satisfactorily proved that wood prepared with these salts inflames with great difficulty, and incinerates with exceeding slowness, so that they may be considered practically as incombustible, and may be employed as such under circumstances where this property becomes of great importance in constructions.

Thus two cabins exactly alike, were constructed, the one of prepared, the other of ordinary wood: to set fire to them equal quantities of combustibles were used. The latter was reduced to ashes, whilst



the inner walls of the former were scarcely carbonized, and the combustion ceased.

Facts of this kind, and others which I purposely omit, appear to me conclusive, and authorize me to think that wood prepared by means of the earthy chlorides is in such a state of resistance to inflammability, and to the maintenance of combustion, that the occurrence of fires is almost impossible, unless they be not only commenced but sustained by materials foreign to the construction of the building.

*Of the introduction into wood of colouring, odorous and resinous matters.*

In order to terminate the enumeration of the various substances which may be introduced by the vital force of aspiration, I must mention colouring, odorous and resinous matters.

The last two classes of substances can only be introduced in solution in alcohol diluted with water, or in various essences. The penetration is then easy, and the wood preserves the odour which has been communicated to it, with the same permanence as do those, the odours of which are natural. Wood impregnated with resins becomes extremely inflammable, and is with difficulty penetrated by water. I shall not dwell farther upon these properties.

As to the colouring of wood, it may be produced either by mineral or by vegetable matters. In the first case, the colouring matter is not immediately introduced, but we present to its absorption two bodies, the mutual decomposition of which determines the formation of a third, which is the coloured body. I have thus frequently obtained a blue colour by causing, in succession to penetrate, a salt of iron, and the prussiate of potassa. By following the same method, and varying the substances, we may also vary the colours produced.

Vegetable matters are not as easily introduced as the preceding. Certain woods even refuse to let them penetrate, however limpid may be the solution used.

When we reflect upon this, is it not natural to inquire whether it may not arise from a difference in size of the mineral and vegetable molecules? and might we not thus make use of the sap vessels of different species of wood to measure the respective sizes of these molecules?

Annales de Chimie, June, 1840.

The following additional process of M. Boucherie is extracted from a more recent journal.—TRANS.

*New researches upon the preservation of timber.*

The process of penetration of wood by the vital aspiration, can only be executed during the running of the sap; and besides, that the time is limited to certain months in the year, the cutting of the wood at that season of the year deranges all established practices, and leaves in many minds the unfounded conviction that wood not cut in winter must, of necessity, be very subject to decay.

These considerations induced the author to seek for an economical means of penetrating wood in winter, and he has succeeded in discovering a mode of penetration differing from that by vital aspiration,

equally economical, complete, by means of which, in the depth of winter, and in a very short space of time, wood may be penetrated either in the bark, or after being squared.

This process, which is only applicable to wood newly cut, and sawn into pieces of any length, consists in placing the wood vertically, and adapting to its upper extremity bags of water-proof stuff, which act as reservoirs, into which are poured the saline, or other solutions, which may be chosen, so as constantly to supply fresh quantities to the wood. In the greater number of cases, the liquid speedily penetrates by the upper extremity, and almost at the same instant the sap escapes below. The process is terminated, when at the lower end of the wood the liquid is collected perfectly identical with that introduced at the upper end.

Bulletin de la Société d'encouragement, pour L'Industrie Nationale.

*Table indicative of the Protective Action exercised by various substances against the Decompositions which certain very alterable Vegetable Matters undergo, when placed under favorable conditions of Moisture and Temperature.*

All these experiments were made at the same time, with the same weights of vegetable matter, upon which was always poured the same quantity of liquid holding in solution different weights of the bodies of which we wished to ascertain the protective action. Equal conditions of humidity were preserved by placing the different substances in precisely similar vessels in the same place, into which were poured, at the same points of time, equal quantities of water to replace that which evaporated.

*Wheat Flour.*—62 grammes: Experiment begun Feb. 25th, 1838.

*Simple Water.*—To establish a point of comparison, I moistened the 62 grs.\* of flour with 30 grs. of water, and observed that on March 5th the whole mass was covered with mould, and disengaged a large quantity of putrid gas.

*Deutochloride of Mercury, (Corrosive Sublimate.)*—Three experiments were made with this substance, and in the first the 30 grs. of water contained 2 decig. of deutochloride; in the second, 4 decig.; in the third, 6 decig. After two months of observations none of these matters presented any traces of alteration.

*Sulphate of Iron, (Copperas.)*—Five experiments were made with this salt; the 30 grs. of water containing respectively 2, 4, and 6 decig., 1 and 2 grs.

In all cases the mould was only retarded for a few days. It was complete upon the twelfth in all the experiments.

*Pyrolignite of Iron, (Areometer 8°.)*—Eight experiments—with from 1 to 8 decig. in 30 grs. of water.

|               |                                  |   |   |   |      |
|---------------|----------------------------------|---|---|---|------|
| With 1 decig. | the mould appeared upon the 10th |   |   |   |      |
| " 2           | "                                | " | " | " | 12th |
| " 3           | "                                | " | " | " | 15th |
| " 4           | "                                | " | " | " | 20th |

\* The abbreviation 'grs.' refers to the French weight, gramme, not to the English grain.

And it is to be observed that in all these experiments it only occupied, at the date indicated, a portion of the surface, and was not complete until eight days later.

With 5, 6, 7, and 8 decig. there was no mould upon April 25th.

*Arsenious Acid.*—Four experiments—the first with 2 decig.; second with 4 decig.; third with 1 gr.; fourth with 2 grs.

In the first case mould commenced upon the 10th of March and was complete on the 16th.

In the second, commenced March 12th, complete March 18th.

In the third, commenced March 15th, complete March 20th.

In the fourth, no alteration upon April 25th.

It must be remarked that in these last two experiments, the arsenic was chiefly in a *state of mere admixture*.

*Saw-Dust of Green Wood.*—Several experiments made with the saw-dust from green wood tend to the belief that 1 gr. of pyrolignite at 8° exercises a protection greater than that of 1 decig. of the deutochloride, which is contrary to the observations made upon flour, and beet pulp.

Moreover the dust of green wood is incomparably more alterable than that from dry wood, no matter with how much water we may mix the latter. This fact is remarkable.

95 grs. of the pulp of the beet, with the juice of which the substances tried were mixed in solution. The experiment commenced February 25th, 1838.

*Pulp in its Natural State.*—This experiment presented several points of mould upon March 3d; upon the 4th the mould occupied one-third of the surface; upon the 5th of March it was complete.

*Deutochloride of Mercury, (Corrosive Sublimate.)*—Six experiments with this substance; all indicated a complete protection, the least quantity used was 1 decig.

*Sulphate of Iron.*—In six experiments the least quantity of this salt used was 3 decig.; the greatest 1½ grs. Upon March 6th they were all completely mouldy.

*Pyrolignite of Iron, (at 8° Ar.)*—1 gr. of this salt was required to obtain a complete protection. Quantities less than 1 gr. had only the effect of retarding the decomposition more or less.

*Pyroligneous Acid.*—6 decig. of this acid completely prevented alteration. This experiment tends to show the powerful protective action of kreosote and the other essential oils which pyroligneous acid contains. It also points out the necessity of not saturating the acid with iron, which necessitates the separation of the kreosote.

*Sulphuric Acid.*—I employed from 1 decig. to 1½ grs. In the latter case it scarcely retarded the alteration for several days.

*Sulphate of Copper.*—This salt employed in the proportions of 1, 2, and 5 decig., 1 and 1½ grs., retarded the decomposition only for two days.

*Sulphate of Zinc.*—The results furnished by the sulphate of zinc were similar to those obtained from sulphate of copper.



*MR. ADCOCK'S Patent Spray Pump.*

Abridged from a Report in the Liverpool Courier of a communication made by Mr. Adcock to the Liverpool Polytechnic Society.

Mr. Adcock stated that his mind had been impressed, for some years past, with the difficulties and heavy expenses attendant on the present systems of pump-work, but that it was very far from his wish to disparage what has hitherto been done by others, or to undervalue, in however minute a degree, the great mechanical knowledge, and high scientific acquirements, which have been devoted to this subject. "On the contrary, sir," said Mr. A., "I could wish it most distinctly to be understood that, in so far as regards the present mode of raising from mines, *in a solid mass*, by pump-work, I do consider that our mining engineers, and especially those of Cornwall, have carried this branch of mechanics to quite as high a state of perfection as any other branch of the same science has been carried by other individuals, in the several other processes of productive industry. But it should be stated that, in the other branches of productive industry, as in the cotton, silk, woollen, flax, lace, hosiery, and iron manufactures, the various mechanical arrangements, their improvements and extension, *being above ground*, are placed prominently before the public eye; while those of the miner, *being beneath the surface of the ground*, are unseen and but little known beyond the immediate districts of their application. Nevertheless, we have an unerring test as to the value and efficiency of the improvements introduced into pump-work, by the knowledge we now possess of the greater depths to which mines can be worked, and the much greater quantities of water that can be raised from them than was done formerly."

At the Consolidated and United Mines, in Cornwall, for example, where the steam-engines that work the pumps make, on the average, eight strokes per minute, the quantity of water raised from the depth of the mine, equal to 180 fathoms, is not less than 3,800 gallons per minute. Hence, as the gallon is ten pounds, and the fathom six feet, the quantity of water raised per minute is not less than 38,000 pounds, or about seventeen tons weight, from a depth of 1,080 feet. If, therefore, the water so raised were allowed to flow at an average speed of one foot per second, or sixty feet per minute, it would form a rivulet five feet wide and two feet deep; and to raise that quantity of water per minute from the depth of the mine, not less than 2,000 horses of steam-engine power are employed, viz:—

3 engines, with cylinders 90 inches diameter each.

|   |       |       |    |        |
|---|-------|-------|----|--------|
| 3 | ditto | ditto | 85 | ditto. |
| 1 | ditto | ditto | 80 | ditto. |
| 2 | ditto | ditto | 65 | ditto. |
| 1 | ditto | ditto | 30 | ditto. |

Each steam-engine working upon the high pressure, expansive, condensing system.

Again, at the Mold Mines, in Flintshire, the quantity of water

raised is more than double the amount of that at the Consolidated and United Mines, or about 8,000 gallons, or 35 $\frac{3}{4}$  tons weight, per minute; but then the depth from which the water is raised is not so great, being, on the average, only fifty fathoms, or 300 feet. In other words, and to compare the effect with that of the Consolidated and United Mines, in Cornwall, the quantity of water raised *per minute* from the Mold Mines, and from a depth of 300 feet, is sufficient to make a rivulet 10 $\frac{3}{4}$  feet wide, and two feet deep, flowing, as in the former case, at the rate of one foot per second, or sixty feet per minute, and to raise this large quantity of water per minute there are employed eight steam-engines and four overshot water-wheels, viz:—

|                                                   |    |       |                  |        |
|---------------------------------------------------|----|-------|------------------|--------|
| 1 engine, with 80 inch cylinder and 22 inch pump. |    |       |                  |        |
| ditto                                             | 66 | ditto | 22               | ditto. |
| ditto                                             | 64 | ditto | 18               | ditto. |
| ditto                                             | 63 | ditto | 18               | ditto. |
| ditto                                             | 60 | ditto | 18               | ditto. |
| ditto                                             | 46 | ditto | 16               | ditto. |
| ditto                                             | 40 | ditto | 12 $\frac{1}{2}$ | ditto. |
| ditto                                             | 36 | ditto | 10               | ditto. |

And the overshot water-wheels are each forty feet diameter, and four feet eight inches wide, working a twenty-two inch pump, and three pumps each, eighteen inches diameter, being one pump to each water-wheel.

The enormous weight of materials in a deep pit is far greater than persons unaccustomed to such investigations could possibly imagine. In illustration of which, said Mr. A., I will now exhibit to the Society the weight of materials for the pit-work of the eighty inch cylinder engine, at the Consolidated and United Mines in Cornwall, to which I have before had occasion to allude:—

|                                  |   |   |   | Tons.             |
|----------------------------------|---|---|---|-------------------|
| Weight of pumps, windbore, &c.,  | - | - | - | 161 $\frac{1}{2}$ |
| “ wood-work,                     | - | - | - | 50                |
| “ moving work,                   | - | - | - | 26                |
| “ pump rods,                     | - | - | - | 40 $\frac{1}{4}$  |
| “ main pump,                     | - | - | - | 94 $\frac{3}{4}$  |
| “ four balances and water lifts, | - | - | - | 96 $\frac{1}{2}$  |
| “ load of water in pumps,        | - | - | - | 38 $\frac{1}{2}$  |

In my prior statement, said Mr. Adcock, respecting the Consolidated and United Mines, I mentioned the depth of the mines to be 180 fathoms, or 1,080 feet. But I should state, that such is the average depth from which the various pumps lift the water, and that some of the pumps lift from greater depths than others. The pumps under consideration, *for example*, lift the water from a depth of 290 fathoms, or 1,740 feet. At this pit there were, and probably are, twelve lifts, or pumps, the one below the other, with a length of stroke equal to eight and three quarter feet, and making, on the average, six and a half strokes per minute. The water raised at each stroke, and discharged at the top of the mine, was equal to 32 $\frac{1}{2}$  gallons, or 325

pounds weight; and to raise that quantity of water, *at each stroke*, 300 tons had, each time, to be put in motion, and its *vis inertiae* to be overcome. Hence, said Mr. Adcock, from what I have stated as regards the great weight of materials, and the large-sized steam-engine employed, it must be perceptible to every one, that the outlay for such a set of pump-work is severely great; and that any considerable reduction of the cost, and the subsequent annual expenses, cannot be regarded otherwise by the miner, than as a great boon conferred upon him.

Mr. Adcock here developed the several successive steps of the progression of his improvements, until, eventually, the complex ideas he originally had were reduced to the present state of perfection, as illustrated by his Patent Spray Pump.

"About two years ago," said Mr. A., "I secured a patent in England, for a new and very peculiar process of raising water from mines and other deep places, by employing the force of *condensed air*, confined within a cylinder, and alternating in its pressure, by the action of the piston within that cylinder, from forty-five to ninety pounds on the square inch.

"The invention, when it had been perfected, was submitted to the attention of miners of extensive experience, and approved of by them; and an order, which I had received, was in progress of execution, and a considerable outlay had been incurred by the parties, when I found it necessary to put a stop to all further proceedings, in consequence of a far more valuable and practically efficient discovery having been made by me, and which, if I may be allowed to use the words of an engineering friend of celebrity, is '*simplicity itself*.'

"For this last invention, I have secured patents in this kingdom, and in several kingdoms abroad.

"The invention is, as you will hereafter find, of an extraordinary character,—the happy result of an elaborate chain, or course of reasoning; and some of the *Prospective Advantages* of the *Patent* may be thus stated:

1. I employ neither pumps nor pump-rods.
2. There is but *one lift*, whatever the depth of the mine.
3. As there is but *one lift*, I employ neither clacks nor valves.
4. The water-pipes, or pump-trees, are made and put down at little cost; they are made of sheet zinc, bent into shape, soldered, and soldered to one another; hence, flanches and screw-bolts are dispensed with.
5. Being made of sheet zinc, the pipes, of course, are of light weight, and therefore require but few, and very slight, horse-trees to support them.
6. Wear and tear, comparatively speaking, there is none.
7. The steam engine that I employ is double-acting, and not single-acting. It is of much less size, and of much less power, and there is not occasion to erect it, as in pump work, at the pit's mouth. On the contrary, one engine may, with facility, be made to work two or three pits, at considerable distances apart.



8. I economise largely in the consumption of fuel; and in tallow, packing, and the leathering of buckets and clacks; also in labour.

9. The ventilation of the mine is produced free of cost. And,

10. In taking up the present plant of a mine, to put down the new, generally speaking, the sale of the old materials will more than repay the cost of the patented apparatus.

"Having thus described to you, gentlemen, in a cursory manner, some of the advantages to be derived from the adoption of the patented apparatus, I will, in the next place, detail the chain of reasoning which led to the discovery.

"In my first patented apparatus, I had, in deep mines, a series of "*lifts*;" the same as in pump-work; consequently as in pump-work I was obliged to employ clacks or valves. Knowing that such clacks or valves are at all times liable to derangement, I was desirous, if possible, to improve the patented apparatus, by substituting a new kind of valve, or one that would lessen the number of those employed. For that purpose, I invented and patented a beautiful, simple, and efficient valve; which, judging from its simplicity and value, together with its non-liability to go out of repair, must become universal in its application to water-works and steam engines.

"By that invention I could make one valve perform the duty of four clacks; and the water-way, which, in the patented valve, is unobstructed, was of the same size as that of the pump-trees.

"Encouraged by the success I had thus experienced, I was emboldened to attempt a still further improvement of the patented apparatus, by endeavouring to lessen, even to a greater extent, the number of clacks employed. Eventually I proposed to myself the question—"*Is it possible, in the raising of water from mines and other deep places, to do without clacks or valves altogether?*"

"I knew this desirable effect could not be produced, if the water had to be raised from the mines in a compact or solid state, as in pump-work. For in a pit, 1,000 feet in depth, the column of water being also 1,000 feet, the pressure of water against the sides of the pipe at the bottom of the mine, would be about 440 lbs. on each square inch, and no pipe that could be conveniently applied in practice, could resist that pressure,—I therefore, in the next place, questioned within myself, whether the water could not be brought up from the mine in a divided state; and the obvious reply to it was, if the water be brought up in a divided state, it must be in a state of vapour or of rain.

"The chain of reasoning, thus far continued, led me to investigate the descending velocities of drops of rain, compared with what those velocities should be, by the laws of gravitation; and I found that by the laws of gravitation, the rain ought to descend towards the earth with a speed constantly accelerating; so that, if the cloud was high from which it fell, it ought by its velocity, and consequently its *momentum*, to inflict evils of a serious nature on all animal and vegetable life.

"Then, how is it that such effect is not produced?

"Simply, by the resistance of the air. Each drop of rain, while in the cloud, may be considered to be in a quiescent state. It begins to

descend, from a state of rest, with a motion constantly accelerating, and thus it continues, until it acquires a certain amount of speed; from which time forth the motion of its descent is uniform.

"This uniformity of motion is produced by the resistance of the air; by its not being able to flow from beneath the drop beyond certain rates of speed under certain amounts of pressure, and the ultimate amount of pressure being determined by the weight of the drop. Hence, the drop descends with an accelerating speed at first, compressing the air more and more immediately beneath it, until the resistance and compression become equal to the weight of the drop—thenceforward its motion is uniform.

"I then proceeded to investigate the greatest descending velocities of drops of rain, and I found that, under ordinary circumstances, they were from eight to twelve feet in a second; from which time, the remaining portion of the reasoning was clear and decisive; namely, if water in globules, of a certain size and weight, like drops of rain, cannot, under ordinary circumstances, and in consequence of the resistance which they meet with in the air, descend with a greater speed than twelve feet in a second, then it is certain that if these drops were in a quiescent state, and a current of air were made to move *upwards*, at a greater speed than twelve feet in a second, these drops would flow upwards instead of downwards, *and that too, whatever the height*. Hence, the invention was perfected. I had only to try the experiment in secret. It far surpassed all that I had expected from it, and I forthwith secured the patents. But other effects have resulted in practice, which I never calculated upon nor expected. I have had an apparatus made, on the patent principle, to raise, agreeably to an order which I had received, forty gallons of water in a minute, forty-two feet in height. It was erected at the works of Messrs. Milne, Travis & Milne, at Shaw, near Manchester. The fan, which gave motion to the air, was only three feet in diameter, and one foot wide, and it made about nine hundred revolutions in a minute. Instead of raising forty gallons forty-two feet in height, it raised at the rate of one hundred and thirty gallons of water in a minute, one hundred and twenty feet in height.

"This effect, so much greater than it ought to have been for the power expended, caused me, for some time, much anxiety of mind. It seems to have arisen from a law of nature which is but little known or understood by practical men. I cannot, however, enter upon details here. It is sufficient for me to state in this place, that the natural tendency of the current of air upwards, from the fan at Shaw was one hundred and sixteen feet in a second; a speed, I believe, hitherto never obtained, or conceived to be possible, in the raising of weights.

"By the present mode of raising water from mines and other deep places, by pumps and pump-rods, and other mechanical contrivances, the water is raised through a series of pipes, in a compact or solid state; in other words, if the depth through which the water must be raised, by one pump or one lift, be one hundred feet, then the pipes, extending to that depth, will be full of water, and the whole column of water in those pipes will be lifted at one and the same time.

"A column of water one hundred feet deep, presses with a force of about forty-five pounds on each square inch of its base.

"Hence, if the diameter of the pump-bucket, or plunger, be twelve inches, and its area, as a consequence, one hundred and thirteen inches, the weight of water to be lifted, *at each stroke*, will be about 5,085 pounds.

"In a deep mine, therefore, containing ten such columns or lifts of water, below one another, and acted on at the same time, by the same pump-rod, extending down the shaft or pit of the mine, the weight of water to be raised will be very great, being not less than 50,850 pounds, or about twenty-three tons.

"Hence to lift such a weight of water, and to overcome the friction of the water in the pipes, together with the *vis inertix* to put such columns of water in motion, and to support its own weight, the pump-rod must be made of great strength; and the steam engine, water wheel, or other prime power, by which the effect must be produced, must be of large size and great power.

"By consequence of that *vis inertix*, the friction and the great weight to be put in motion—and when steam engines are employed, the alternate action or reciprocation of the great lever or beam of the engine—the number of feet of *effective* strokes, made per minute, is comparatively small, being generally in deep mines, from about fifty to eighty feet. To explain this more fully, the whole mass of water in the ten columns, having to be raised at one and the same time, and therefore being equal in weight to one column of water of the same diameter and 1,000 feet in depth, may be considered as being lifted in the mass, through a distance of fifty, or from that to eighty, feet in a minute. Whereas by my '*Improvements in raising water from mines and other deep places, or from a lower level to a higher, which improvements are applicable to the raising of liquids generally, and to other purposes*,' I do not raise water or other liquids in the mass, nor do I find it necessary to exert a pressure, at one and the same time, of forty-five pounds on each square inch, when the height to which the water must be raised is one hundred feet; nor do I raise water by pumps and pump-rods; but in the manner now to be described.

"That is to say, by the aid of a steam engine, water wheel, or other prime mover, I give motion to a fan, or fanner, (such as is used very commonly by foundry men, engineers, mill-wrights, and others, to force a current of air into cupolas and other kinds of furnaces,) or to the piston of a blowing cylinder, (such as is used by iron masters and makers of iron, to force a current of air into blast furnaces, for the reduction of ores,) and, by aid of such fan or fanner, or blowing cylinder, I condense atmospheric air that it may, when liberated from its confinement, have a tendency to escape into the atmosphere with a velocity due to its pressure.

"When atmospheric air is condensed to a quarter of a pound pressure per square inch beyond the atmospheric pressure, and is liberated from its confinement, it moves, or has a tendency so to do, at the rate of one hundred and seventy-three feet in each second of time; at



half a pound pressure per square inch, the speed due to the pressure is two hundred and forty-five feet per second; at three-quarters of a pound pressure, two hundred and ninety-six feet; at one pound, three hundred and forty feet; at a pound and a quarter, three hundred and seventy-five feet; at a pound and a half, four hundred and ten feet; at a pound and three-quarters, four hundred and thirty-six feet; at two pounds, four hundred and sixty-seven feet; at three pounds, five hundred and fifty-five feet; at four pounds, six hundred and twenty-four feet; and at other pressures, with other velocities or rates of speed, as may be known by reference to, or consulting the Treatises that have been published on, the science of Pneumatics.

“Now, instead of raising water in the mass, as herein before described, by pumps and pump-rods, and such like contrivances, I avail myself of the mechanical effects that may be obtained from the velocities of the air, as due to the pressures herein before made known, or any other pressures that circumstances connected with mines, in different localities, may prove to be desirable.

“I cause the water that must be raised from the mine, or from a lower level to a higher, to be dispersed and carried up in drops, like drops of rain; but the velocity of those drops *upwards*, in consequence of the velocity of the air, is far greater than the *descending* velocities of rain.

“For drops of rain, when not receiving an impulse from winds, can only descend through the atmosphere with a speed of about eight feet in a second, when the diameter of each sphere or drop of rain is the hundredth part of an inch. When the diameter of the drop is the sixteenth part of an inch, the greatest descending velocity through the atmosphere is about seventeen feet in a second; and the velocities in a second, through the atmosphere, for drops of rain of other diameters, may be thus stated: for drops of rain an eighth of an inch diameter, twenty-four feet; for drops three-sixteenths of an inch diameter, thirty feet; and for drops a quarter of an inch diameter, thirty-four feet per second. Whereas, the velocity of the air, when allowed to escape from a pipe upwards at one pound pressure per square inch beyond the atmosphere, and without making any deductions for the friction against the sides of the pipes, is about three hundred and forty feet in a second. But it should be stated that, when the air is commingled with the water that must be carried up by it from a mine, or from a lower level to a higher, its motion, to a certain extent, is retarded. The velocity of the drops of water *upwards*, however, by this mode, or by these modes of raising water from mines and other deep places, is far greater than the velocities at which rain usually descends, as herein before has been described.”

Mr. Adcock's invention has been put down, *practically*, at the Pemberton Pit, Wigan, which is under the management of Mr. Robert Daglish. The pit is one hundred yards deep, and Mr. Adcock proposes to bring up from that depth from two hundred and forty to three hundred gallons per minute; and, from a preliminary trial already made, there appears to be no doubt as to the success of the invention.

London Mech. Mag., June, 1841.

## Mechanics' Register.

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LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1840.

*With Remarks and Exemplifications by the Editor.*

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1. For a *Self-Acting Mule for Spinning*; William Mason, Taunton, Bristol county, Massachusetts, October 8.

'It would require the whole of the specification and drawings of this instrument to make known the peculiarities upon which the claims are dependent, and we shall not, therefore, attempt any analysis of it. Such a machine is necessarily very complex, and in many of its parts it must be similar to others for the same purpose which have been patented in England and in the United States.

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2. For an improvement in *Piano Fortes*; Jonas Chickering, Boston, Massachusetts, October 8.

This patent is obtained for an improvement in iron framed pianos, and the improvement consists in attaching or combining the bridge, over which the strings pass, to the straining pins, and the socket, through which the damper wires pass, to the iron frame, by casting them thereon, or by casting the whole together in one piece.

The claim is confined to this device and is expressed nearly in the above words.

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3. For an improvement in the machine for *Hulling Rice* and other seed; William C. Grimes, York, York county, Pennsylvania, October 8.

The following are extracts from the specification.—“For hulling and scouring rice no principle of action has been found, perhaps, more applicable or efficient than the percussion of pestles or stampers acting upon a mass of it more or less confined. But the manner of applying this action as heretofore is imperfect, in as much as all reciprocating motion in a machine for this or other similar purpose must necessarily be.”

“In my machine the motions of all the moving parts are rotary, whilst the action upon the rice or other seed is similar to that of a pestle upon a dense and partially confined mass of it; while at the same time, it is constantly receiving at one point and discharging at another, no time being lost for that purpose.”

“This machine consists of a hollow metallic cylinder which revolves rapidly on its own axis; within this cylinder, where the hulling is effected, revolves another in the same direction, and about as much oftener as it is smaller in diameter. The axes of these cylinders are very eccentric, the great difference in their diameters allowing of this arrangement.”

The small cylinder is armed with six or more rows of long teeth, and its axis is equally distant between the axis and periphery of the

large cylinder, so that its teeth will nearly touch the inner periphery of the large one. The upper end of the large cylinder is open, and is attached to its shaft at the bottom alone, so as to allow of its turning independently of the small one, the axis of which is permanent, and its shaft being attached to the frame at the top alone. The grain is fed in at the top and discharged at the bottom. As the large cylinder revolves with considerable velocity the centrifugal force will concentrate the rice around its inner surface; and as the axis of the small cylinder does not revolve with the large one, its teeth act upon all the rice thus concentrated.

The claim is to the "mode of hulling rice, seed, or grain, by means of the combined action of a rapidly revolving hollow cylinder and one or more smaller cylinders armed with pins, teeth, or projections, revolving upon a fixed axis and operating as set forth, it being eccentric with, and within, the former, where the hulling and scouring are effected; the said projections acting upon the rice while it densely lines, by centrifugal force, the inner surface of the hollow cylinder as before specified. I claim the application of centrifugal force to this purpose, applied in the manner specified."

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4. For improvements in the *Process of Manufacturing White Lead*; Horace Cory, Great Britain, October 8.

The first improvement claimed under this patent is the combination of the process of making lime with that for making carbonate of lead, or white lead, whereby the carbonic acid gas, evolved in the first process, is made to pass through a solution of lead and convert it into carbonate.

The second improvement claimed is for a mode of submitting a solution of lead, prepared in any known manner, to a current of carbonic acid gas. A chamber is so divided by partitions that the gas will pass down one space, then under the partition up a second space, then over a second partition, and so on, through any given number of spaces, and then out at the chimney. Each space, in which the gas descends, is covered with a perforated plate, and through the perforations in these plates the solution of lead drops, and in passing down it comes into contact with the carbonic acid gas and is converted into carbonate of lead. The solution thus impregnated with carbonic acid gas, passes into precipitating vats, and after the carbonate of lead has subsided, the surplus solution is pumped back, and is again passed through the impregnating chamber.

The claim is, first, to the "combining of the process of making white lead with the process of making lime, whereby the carbonic acid gas evolved in the latter process is beneficially applied in place of permitting it to pass into the atmosphere. And secondly to the mode of submitting suitable solutions of lead to the action of carbonic acid gas as above described."



5. For *Evaporating Solutions, Decoctions, &c., for the purpose of Concentrating them*; James W. W. Gordon, Baltimore, Maryland, October 8.

The patentee says, "The object of my improvement is principally to obviate the danger of injuring the preparation, which in articles of great delicacy sometimes takes place, by the application of the heat of a water or steam bath only; and this I effect by means of a machine which produces rapid evaporation at the ordinary temperature of the atmosphere."

This machine consists of a table either flat or convex, which is made to revolve either horizontally or vertically, and upon which the solution, &c., is suffered to percolate. The evaporation is accelerated by thus passing the fluid through the air with considerable velocity.

The claim is to the "employment of a revolving table, constructed and operating substantially in the manner of that herein described for the evaporating of decoctions, infusions, or solutions, and the producing of pharmaceutical extracts without artificial heat, as described."

The extracts thus formed are very favourably spoken of by those who have used them; they are not only superior in colour and general appearance to those made by heat, but in many instances retain those qualities upon which their value is dependent, in a manner much more perfect.

6. For an improved *Flyer for Twisting Silk, &c.*; Edward L. Young, Norfolk, Virginia, October 8.

This flyer, instead of having the two guide wires run out their whole length parallel to, and at equal distances from the axis, has one short and one long guide wire—the short wire, or arm, extends as far only as the middle of the bobbin, and the longer arm extends to some distance beyond the end of the bobbin, and is there curved so as to bring the guide in a line with the axis of the bobbin—the guide wire being sufficiently long to admit of putting on and taking off the bobbin without moving the flyer. A ring is attached to the two guide wires of this flyer, near the extreme end of the short arm, to prevent the centrifugal force from throwing out the guide wires which constitute the flyer.

The claim is to this method of constructing the flyer.

7. For an improvement in the *Method of Raising and Lowering Venitian Blinds*; John Weir, city of New York, October 8.

The improved method of raising blinds consists in attaching the upper end of the cords, that pass through the slats, to a roller at the top, which is turned by two cords that wind and unwind on a barrel at the end of the roller. There is a ratchet wheel on one end of the roller, into the teeth of which a pall catches. A cord is used to disengage the ratchet to allow the blinds to descend. By means of this arrangement the blinds may be raised and lowered, and retained

at any point desired, without attaching the cords to knobs as heretofore.

The claim is to the "mode of raising and lowering venitian blinds, and retaining them at any height without the operation of fixing the cords, by means of the combination of the blinds, the cords passing through the slats, the roller, the barrel on the end of the roller, and the cord passing around the same, and the ratchet wheel and catch, as described."

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8. For an improvement in the manner of constructing *Railway Tracks*; Benjamin H. Latrobe, Civil Engineer, Baltimore, Maryland, October 8.

For a description of the railway which is the subject of this patent, see vol. i, third series, p. 173.

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9. For a new *Manufacture of Cloths from worn out Wool or Silk Goods*; Reuben Daniels, Woodstock, Windsor county, Vermont, October 8.

(See specification.)

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10. For an improvement in *Fire Arms*; Silas Day, city of New York, October 8.

This patent is obtained for an improvement on that kind of fire arms that load at the breech, and it consists in making a curved chamber at the breech, which opens at the side of the barrel, for the reception of the load. The side aperture is closed by a valve which works on a pin and is provided with a handle and catch, the valve works in a slot made in a block of iron that projects from the side of the barrel, and in which block a part of the curved chamber is made.

"I am aware," says the patentee, "that guns have been made to load at the breech by having a sliding valve to close the aperture through which the charge is inserted, but not constructed like the plan herein described, and therefore I do not claim the principle of loading at the breech as my invention, but what I do claim as my invention, and desire to secure by letters patent, is the curved chamber, and in combination therewith the sliding valve and its appendages, consisting of the slot and lever, for the purpose, and in the manner herein described."

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11. For an improvement in the machine for *Cutting the Teeth of Metal Combs*; Joseph C. Ives, Bristol, Hartford county, Connecticut, October 8.

The object of this improvement is to prevent the tooth, which is being cut, from curling from the operation of the saw; an effect well known to all workers in metal. A stud is to be added to the sawing machine, which stud works on a joint pin, and is borne up by a spring; it is distant from the saw the thickness of a tooth, so that the tooth which is being cut, is held against the face of the saw, and is thus

prevented from curving. As the saw cuts into the comb plate the stud yields and allows the plate to move towards the saw.

The claim is to "pressing the tooth while cutting against the side of the saw in the manner and for the purpose specified."

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12. For improvements in the manner of constructing *Locomotive and other Carriages*; Alfred C. Jones, city of Philadelphia, October 10.

In the specification on this patent various improvements are proposed; the first of these improvements has for its object the more perfect attainment of an equal bearing of the driving wheels on the road, using therefor, the ordinary sized springs of locomotives, or other carriages, but these being so arranged and combined as to produce the intended effect, on being applied to carriages of four or of six wheels.

For a four wheeled carriage the patentee employs two bell cranks, or bent levers, on each side of the carriage. The bearings of the two are near together, and one arm of each runs out horizontally, the other vertically, either up or down. The ends of the horizontal arms bear upon the sliding boxes, in which the gudgeons of the axles work; and between the two vertical arms is placed the elliptical spring. When the principle is applied to a six wheeled carriage, four such levers are employed, the ends of the two inner levers resting upon the sliding box of the axle of the middle wheels.

The claim to this improvement is as follows, viz: "What I claim as my invention in this part of my improvements in railroad carriages of various descriptions, is the application of the bell crank or bent lever between the axle boxes and double or single elliptical springs, standing vertically and combined and arranged as above set forth."

The object of the second improvement is to throw a larger part of the weight of the carriage on the wheel which is passing over an elevation of the road, when it has become uneven, and thereby to tend to level it. To effect this, the ends of a bar, on each side of the car, rest on the sliding boxes of the front and rear axles, and the connexion, between this bar and the spring, is by means of two straps, or lugs, so that when one wheel is lifted up, the connexion between the bar and the spring is transferred to the strap, lug, or other means of connexion, nearest this wheel, and thus the larger part of the weight has to be sustained by it.

The claim to this second improvement is to the "manner of applying the principle of transferring a portion of the weight of the carriage or load from one wheel to another, so as to increase the pressure upon the wheel which may be upon an unduly elevated part of the rail, and decrease it on that which may be in a hollow or depression."

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13. For a machine for *Reducing worn out Cloths of various kinds to the state of Wool to be spun into yarn for the Manufacture of Cloths*; Reuben Daniels, Woodstock, Windsor county, Vermont, October 10.

This machine is, in its general features, similar to the paper engine



for dressing pulp in the manufacture of paper, excepting that the cylinder, instead of being armed with knives, is studded with teeth, and works against a concave of small rollers, also studded with teeth. The worn out cloths, or silks, may be first reduced into shreds by toothed cylinders, or other apparatus, and then put into the water, in which the lower part of the cylinder and the concave of rollers work, and thus brought under the action of the teeth, which take out the twist.

Claim.—“Having thus fully described the manner in which I construct my machine for reducing woolen rags and also worn out silks into fibrous stock, fit to be re-manufactured, it is to be understood that I do not claim the mere use of cylinders furnished with teeth, or points, for the purpose of tearing or reducing woolen or other rags into fibres, but what I do claim as constituting my invention, and desire to secure by letters patent, is the use of cylinders furnished with teeth or points, and operating under water, or other fluid, in a machine similar in its general form to that used by paper makers in preparing their pulp, but combined with the concave of small cylinders, and operating in the manner described.”

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14. For an improved *Cooking Stove*; R. G. Cochran, Francistown, Hillsborough county, New Hampshire, October 10.

The patentee says, “that his improvement is in the manner of constructing a cooking stove, by which it is adapted to the heating of air, and to the conveying of air so heated for the warming of apartments in dwellings.”

An air chest is made between the fire chamber and the descending flue, in front of the oven, so that the draught passes up in front of the air chest, over the top, down between the back of the air chest and front of the oven, &c. &c. Air is admitted to the air chest by a pipe at the side or bottom, and conducted out through a trunk which extends over the oven, and thence through a pipe to the apartment to be heated. The oven, when not used for baking, is employed as auxiliary to the air chest by being provided with a pipe to admit cold air into it, and an aperture, governed by a valve, for conducting the hot air to the trunk which conveys the hot air from the chest. These various pipes and apertures are to be governed by valves or dampers.

The patentee says, “I claim the manner in which I have combined and arranged the air chest for heating air with a cooking stove, rendering the oven or ovens of such stoves auxiliary thereto by converting them into air heating chambers, and connecting them with the air chamber first named, in the manner and for the purpose herein set forth.”

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15. For an improved machine for *Working and Pressing Butter*; Titus D. Gail, Eden, Erie county, New York, October 10.

This machine is for working and pressing butter to separate it from the buttermilk and to press it into balls or lumps of definite size. The machine is described as consisting of a table pierced with two square

holes, fitted with pistons, working from below. Above these perforations a trough is formed by two side boards, in which work three pistons, one vertically and the other two horizontally, one at each end; the three being so connected that by pressing down that which is vertical, the others are forced apart, and when it is drawn up they are pressed together, and thus the butter is alternately worked and the buttermilk separated from it. The butter is then forced into the square holes, or boxes, to form it into balls, the size of which will be regulated by the pistons that work in said boxes.

Claim.—“What I claim is the combination of the horizontal pistons working within the side boards, and operated by the levers, and also the vertical block, or piston, attached and operated by the lever, likewise the table constructed with boxes, all as described; and in combination therewith the box or mould pistons and the slide, for the purpose set forth.”

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16. For an improvement in the method of *Cutting Screws on the Rails of Bedsteads*; Jacob Lindley, Cynthiana, Harrison county, Kentucky, October 10.

The ordinary method of cutting screws upon the ends of bedstead rails, is well known to all who are acquainted with the making of such articles. In the improved mode, the rail is held in the middle by a clamp attached to a bench, on each end of which there is a puppet head in which works a screw, mandrel, or shaft, provided with a winch on its outer end, and on the inner end of each of these is fitted a socket, very similar to those usually employed for cutting wooden screws, excepting that they are made of steel, and the cutter is formed by it, instead of being attached thereto. These sockets are fitted on to the inner ends of the screw, mandrel, or shaft, by a socket, and secured by a thumb screw, by means of which the precise point at which the threads, on each end of the rail shall end, can be regulated. That end of the socket, on which the cutter is situated, is beveled off, and the cutter is so formed as to cut under the shoulder.

The claim is to the “manner of forming the cutters for cutting the screws on the ends of the rails, by making them a part of, and one with, the sockets, or female screws. Also, the manner in which I have combined and arranged these sockets, the screw shafts, and standards (puppets) with each other, for the purpose set forth.”

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17. For a machine for *Pricking Leather preparatory to sewing*; Samuel Sheldon, Cincinnati, Hamilton county, Ohio, October 10.

This machine consists of a clamp for holding the leather, attached to a sliding carriage, and a slide to which the awl is attached, said awl having a sliding reciprocating motion at right angles to the motion of the leather in the clamp. The awl slide is moved by means of a crank pin on a wheel attached to the fly wheel shaft, and a strap, operated by the awl slide, passes over a roller and has a sliding plate suspended from it, provided with a pin which may be shifted along a set of holes; as the sliding plate is worked up and down by the strap, the

pin strikes against a handle and thus actuates a rag wheel, from which motion is communicated to the clamp carriage; the degree of this motion may be regulated by shifting the pin on the sliding plate, the distance apart of the holes pricked in the leather being thereby determined at pleasure. The motion of the awl and the leather may also be regulated by shifting the crank pin on the wheel, by which the awl slide is actuated.

The claim refers by letters to the drawings, but it is confined to the arrangements above indicated for regulating the feed which moves the carriage and clamp.

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18. For improvements in the *Machine for Pricking Leather preparatory to sewing*; Samuel Sheldon, Cincinnati, Hamilton county, Ohio, October 10.

The claim under this patent is to the "manner of combining and arranging the apparatus for moving the awl back and forth, as described, said combination consisting of the strap shaft, with the strap attached thereto, and the pinion thereon, taking into the rack on the awl shaft, the metal rods and the spring, substituted for the leather strap and the spring in his patent of August 3rd, 1839. And also to the manner of combining the screws and swivel-nuts with the clamp for holding the leather."

The difference between this and the first named machine is principally for the purpose of adapting it to the heavier kinds of work, such as thorough braces, &c.; the particular manner of effecting this we shall not attempt to describe.

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19. For improvements in the mode of *Supplying Steam Boilers*; Benjamin M. Hyatt, Wilmington, Delaware, October 10.

A cylinder is placed above the boiler, with one pipe leading from the bottom thereof nearly to the bottom of the boiler, another from the upper part of said cylinder to the top of the boiler, and a third either to a cistern above, or a well below. All these pipes are provided with stop cocks to be worked at proper intervals by the engine. When the third pipe connects the cylinder with a well below, the operation is as follows, viz: steam is admitted from the boiler to the cylinder through the first named pipe, and by its condensation forms a vacuum in the cylinder, which is to be filled with water from the well, by atmospheric pressure through the third pipe; steam is then again admitted through the first pipe, to make the pressure above the water in the cylinder equal to the pressure in the boiler, and the water is then admitted to the boiler through the second pipe. When the third pipe leads from the cylinder to a cistern above, instead of a well, steam is admitted into the cylinder only for the purpose of equalizing the pressure.

The patentee says, "I am aware that steam boilers have been constructed with a supply cistern, in some respects like mine, that is with a chamber or cistern placed above them having tubes governed by



stop cocks connecting the top and bottom of the cistern with the boiler for the purpose of equalizing the pressure of the steam upon the water and allowing it to descend into the boiler as herein described. I do not, therefore, claim the raising of water by the condensation of steam in a vessel for that purpose; but what I do claim is the combination for raising water and supplying a steam boiler therewith, as herein set forth; that is to say, by the use of the pipes leading from the cylinder into the boiler, combined with the respective stop cocks connected with the cylinder and the boiler, said cocks being operated by the stroke of the steam engine in any convenient way, so as to allow the steam in the cistern at every stroke of the piston to come in contact with the tube leading to the well, so as to produce a rapid condensation, and a consequent vacuum for the admission of water from the supply reservoir, or well.

I also claim the combination and arrangement as above set forth for supplying water to the boiler from the cistern, or from any sufficient source above the boiler, the combination and the action of the respective cocks by the power of the engine being in all respects as herein set forth, with the exception of the apparatus for raising the water from a well or reservoir below the boiler.

I wish to be understood, also, as not claiming in this the raising of water into a cistern connected with a steam boiler by atmospheric pressure, steam being admitted from the boiler into the cistern and condensed as in my arrangement, unless the mode of supplying the boiler from the cistern by balancing the pressure of the steam be employed as herein described."

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20. For an improved mode of *Propelling Boats on Canals*; Mellen Battel, Albany, New York, October 14.

The improvement proposed is in the well known mode of propelling canal boats by means of a wheel running on the bottom of the canal. The wheel is to be made with paddles, in the usual way, and there are to be projections on the outer edges thereof to catch and hold on to the bottom of the canal, so that in shallow water the wheel may be employed to run on the bottom, and in deep water to act merely as a paddle wheel. The wheel is placed between two boats, or between the sections of what is usually called a twin boat; it has its bearings in two vibrating balance beams, to which the engine is also attached, so that the wheel may accommodate itself to the inequalities of the bottom.

The claim is to the "forming of the combined ground and paddle wheel, so as to run upon the bottom of a canal and to propel the boat by the hold or friction of the cross bars and the rims alone, and when raised from the bottom to effect the propelling by the buckets, or paddles; said wheel being connected and combined with a vibrating frame within the body of the boat, which frame also sustains the steam cylinders in the manner set forth, and the respective parts concerned in the operation of propelling being arranged and operating substantially in the manner herein described."

21. For a *Cooking Stove for Burning Bituminous Coal*; Wm. B. Lawrence, Cincinnati, Ohio, October 14.

The patentee remarks that "one of the principal causes of complaint in the operation of baking in cooking stoves is the result of the accumulation of soot and ashes in the flues, which being very bad conductors of heat prevent the heating of the oven plates, the air from the fire making its escape without communicating its heat where alone it is wanted; to obviate this difficulty is the main object of my improvement.

"Said improvement consists, in the first place, in the forming of a scraper which may be cast in one piece, or which may be made by the uniting of several plates together so as to constitute one piece, and which, when in place, shall occupy the flue space above, below, and on each side of the oven, and shall have rods attached to it that pass through holes in one of the side plates of the stove, terminating in handles on the outside, in such manner as to admit of the moving of said scrapers back and forth within the flues, and simultaneously to remove the accumulated soot and ashes therefrom on every side. And secondly, for the purpose of discharging the soot which has been scraped off from the flues, I make perforations, or longitudinal openings, through the iron plate which forms the lower side of the bottom oven flue, and place under this plate a drawer, or other receptacle, into which the soot and ashes shall fall, and from which they can be readily removed whenever the same may become necessary."

The claim is to the "manner of cleaning the flues surrounding the ovens of stoves of various kinds by the use of a scraper, cast or otherwise made in one piece so as to surround the oven on four sides; and in combination therewith the respective openings in the bottom plate leading into the draw, or receptacle, for the soot and ashes."

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22. For an improvement in the *Spark Arrester for Locomotive and other Carriages*; Randall Fish, New York city, October 14.

In this spark arrester the usual chimney is surrounded by a drum divided into chambers by vertical partitions running from it to the inner periphery of the drum. The draught is conducted through a pipe into the first chamber, from this chamber into the next through a pipe in the partition, and so on until it has passed through all the chambers, from the last of which it is conducted back into the chimney through an opening near the top of the drum. The pipes that form the communications, from the chimney to the drum, and from chamber to chamber, are inclined downwards at an angle of about forty-five degrees. The drum is provided with a receptacle at the bottom to receive the sparks.

The claim, if given, would be merely a repetition of the foregoing arrangement, and we do not, therefore, insert it.

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23. For an improved *Ever Pointed Pencil Case*; Thomas Woodward, city of Brooklyn, New York, October 14.

The object of this improvement is to prevent the heads and points

of pencil cases from becoming loose, where they are screwed on to the body of the case, and this is to be effected by the introduction of a sliding bolt at top and bottom, which slides within the case and revolving tip, and catches into a notch made in the head and point for its reception. Instead of the bolt the patentee describes another method of preventing the point from becoming loose, which consists in forming a conical joint, instead of a square shoulder, on the point and revolving tip where the two are united together by a screw.

The claim is to the "employment of a bolt, or catch, formed and operating substantially as described, in combination with the ordinary screw for securing the heads and points of such cases, and also, in lieu of such bolt or catch, at the point and tip, the combining of the cone with the ordinary screw, in the manner and for the purpose set forth, and applied to the ever pointed pencil case."

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24. For an improvement in the manner of making the *Wheels of Railroad Carriages*; Albert Fuller, Providence, Rhode Island, October 14.

In this wheel the rim is to be cast with a chilled flanch, and the tread is sunk to receive a wrought iron tire, which is put on while hot, so that the contraction of the metal as it cools will secure it in place; and it may be further secured by bolts.

Claim.—"What I claim as my invention and desire to secure by letters patent is, placing the tire in the sink in combination with the cast iron chilled flanch, for the purpose and in the manner described."

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25. For a machine for *Cutting Vegetables*; George J. Neveil, Rising Sun, Philadelphia county, Pennsylvania, October 14.

The machine described by the patentee is for cutting vegetables for the feeding of cattle, and it may be applied also to other purposes; it consists of a hollow truncated cone, provided with cutters, and revolving on an horizontal shaft or axis within an inclined hopper provided with a sliding gauge on the side towards which the cutters revolve, for the purpose of aiding to regulate the cutting apparatus.

The general nature of the improvement will be understood by reference to the following claim, viz: "I do not claim a hollow truncated cone, inclined hopper, sliding gauge, or frame, but what I do claim as my invention, and which I desire to secure by letters patent, consists of the before described mode of constructing the hollow truncated cone of cutters for cutting vegetables, roots, &c., namely by means of the open and solid beads grooved on the faces towards each other to admit the ends of the segments and knives, and held together by rods and screws arranged in such a manner that they can be loosened at pleasure for the purpose of setting the segments nearer to or farther from the cutting edges of the knives, for the purpose of cutting coarser or finer and again tightened to hold them securely in the position in which they are set, all as described."



26. For a method of *Rendering Hats Buoyant, to be employed as Life Preservers*; Samuel White, England, October 14.

A water proof chamber is made in the upper part of a hat, cap, or bonnet, by means of a division placed sufficiently high to be beyond the reach of the top of the head. The whole of the hat, &c., is made water proof, and the lining is provided with a tube, so that by drawing out the lining, and inflating it with air, through this tube, the whole will have considerable buoyancy.

The claim is, "first, to the making of hats, caps, and bonnets with a space water proof, as above described. And secondly, to the application of a water proof lining for the purpose of preventing persons from sinking in the water."

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27. For an improvement in the *Cooking Stove*; James Parmalee, Ogden, Monroe county, New York, October 14.

The improvement claimed in this patent is for an arrangement of the dampers and plates to give a new direction to the draught. In addition to the front set of boilers usually employed in cooking stoves there is another set over the forward part of the oven. Between the bottom of these boilers and the top plate of the oven, there is a plate which extends from the back plate of the fire chamber to the back of the stove, and the passage between this plate and the top plate of the stove is closed, when desired, by a damper, and that between this plate and the top plate of the oven is closed by a partition running across the stove; the partition and the damper being behind the second row of boilers above mentioned. The intermediate plate is provided with two openings, one in front and the other behind the partition. When the oven is not in use the damper is to be turned down, and then the draught passes under the boilers and directly out to the smoke pipe near the back; but when the oven is to be heated, the damper is closed, and the draught then passes under the boilers, through the hole in the intermediate plate, over a part of the oven, down the front, under the bottom, up the back, then over the other part of the top, and through the second hole in the intermediate plate to the pipe. The claim is limited to this particular arrangement of the flues, partitions, and dampers.

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28. For a *Boiler for Heating Water for Culinary Purposes, and for Generating Steam*; Daniel L. Pickard, Hartland, Niagara county, New York, October 14.

The furnace in this apparatus is placed within the boiler, which may be cylindrical, and the space between the furnace and the cylinder, at the sides and top, is occupied by alternate flues and water chambers, formed by means of convolute plates, so that the draught passes up over the top of the first water chamber, on each side, down between the first and second water chambers, and up between the second and third, and thence out at the chimney, which chimney passes

through the outer water chamber. All the water chambers open into a water space at the end.

Claim.—“Having thus fully described the manner in which I construct my boiler, what I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the respective parts, consisting of the exterior case, the furnace, the convolute flues and water spaces, and the end water space, or bulk-head, as described.”

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29. For a *Machine for Crozing and Chiming Staves for Barrels*, &c.; Charles F. Beverly, Salem, Columbiana county, Ohio, October 16.

The croze and chime of staves are to be formed by this machine, on the face of the block from which the stave is to be cut. On the face of the gate, to which the knife, that cuts the stave, is attached, there are two cutters of the form of the croze and chime, placed as much farther back than the knife as will form the desired thickness of the stave; these cutters shear against the edge of a plate having depressions to correspond with their shape, said plate is attached to a sliding platform, which is acted upon by a spring to force the plate into its proper position to insure cutting, and by means of cam pieces, attached to the gate, between the stave knife and cutters, it is pushed back, clear of the stave knife, at each operation.

The claim is to the manner of forming the cutters, for cutting the croze and chime in combination with the depressions and bevels on the plate against which they cut.

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30. For improvements in the *Machine for Planting Corn*; Martin Nichols, Clearfield, Clearfield county, Pennsylvania, October 16.

The description of this machine is of great length, and the claims refer to the drawings, and could not be understood without them.

The corn, or other seed, is to be dropped by means of cups attached to a band passing around two drums, in a manner well known to those who are conversant with planting machines. Two rows are to be planted simultaneously, one on each side of the machine. The first claim is to the manner of arranging a plough beam, by attaching it, by a joint pin or bolt, at one end to the frame of the machine, and at the other end to a sword piece which passes up through a mortise in the frame—the depth to which it shall sink being regulated by a pin. The second claim is to the combining with the above a windlass and levers by means of which the plough may be raised, and a roller attached to the end of one of the levers, depressed, to relieve the plough and coverers.

The third claim is to the combining with the plough and coverers two stampers which stamp the earth after the rows have been covered—they are attached to levers and worked up and down by means of tappets on a revolving shaft.

The last claim is to the manner of arranging and operating a brush or striker for clearing the cups of any surplus grain. The brush is

attached to a vibrating lever operated by a grooved cam on a revolving shaft.

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31. For an improvement in the *Reaction Water Wheel*; Archibald Bryce, Campbelltown, Steuben county, New York, October 16.

Reacting water wheels have sometimes been so formed as to have the issues, or outlets for the water, near the periphery, and extending from top to bottom of the wheel, supposing the wheel to be horizontal, or they have been made to extend from the hub, or shaft, of the wheel, to the periphery, in a manner similar to the old tub wheel. The present wheel is a combination of these two, excepting that the bottom issues, or outlets, are gradually increased in size from the hub or shaft to the periphery, making them of a triangular form.

The patentee says—"What I claim as my invention and desire to secure by letters patent, is the combination of the inclined plane and triangular issue with the curved segment side, as described, by means of which arrangement the water is thrown to, and discharged at the periphery of the wheel instead of discharging the whole distance from the centre to the periphery as heretofore; and also the triangular issues in the bottom combined with the rectangular issue in the circumference of the wheel as set forth."

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32. For a mode of *Hauling off Stranded Vessels*; Thomas Bell, Bellport, Suffolk county, New York, October 22.

This patent is obtained for a peculiar arrangement of lines with buoys made fast to anchors and passing from the stranded vessel to another, which is to be properly secured by anchors. And also for attaching buoys to the stranded vessel to assist in floating it as it enters the water. The whole arrangement could not be understood without reference to the drawings; the claim, however, will afford a general idea of the plan.

Claim.—"I claim the manner of arranging and combining the large anchors, chains, and buoys, and of connecting them with the stranded vessel, with the chain, or rope, rove through said blocks so as to be acted upon by the windlass of the vessel. I claim in combination with the foregoing, the manner of employing the air tight buoys, attached to a vessel on a beach, for the purpose of aiding in giving her buoyancy, when being hauled off by the purchase herein described."

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33. For a mode of *Shifting Switches on Railroads*; Richard W. Sheckells, Baltimore, Maryland, October 22.

The switches which are the subject of this patent are to be shifted by the car. The two switches are connected with a bar which slides at right angles to the rails, and this bar is jointed to one or two levers on each side of the track, and these are acted upon by two keys jointed to a balance lever, or beam, in front of the car. The levers that are jointed to the switch bar are so curved that as the car approaches the switches, one of them will be acted upon by that key on the car which is down; their attachment by a joint to the balance lever, or



beam admitting of their being moved up and down by the engineer, so as to shift the switches to either side, as desired by him. The switch bar has two projections, one on each side, by which it is locked at each shift of the switches, the locking being effected by two springs, one acting on each projection, provided with a cam piece, so that in shifting the switches sufficient force must be applied to enable the projections on the bar to overcome the pressure of the springs and pass over the cam pieces thereon.

Claim.—“What I claim as my invention, and desire to secure by letters patent, is not the principle of shifting the switches by means of a projection from the car acting against a lever connected with the switch, as this has long since been done, but what I do claim, is the method of connecting the switches with the sets of levers, one set on each side of the track, or one lever on each side of the track, in combination with the keys on the beam, in the manner and for the purpose described; and I also claim the mode herein described of locking the switches by means of the apparatus described.”

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34. For an improvement in the *Machine for Knitting Stockings*; Benjamin Hutchinson, Jr., Springfield, Hampden county, Massachusetts, October 22.

This improvement is on the kind of knitting machine noticed in the second series of this Journal, vol. viii, p. 10, and vol. xx, p. 336. In the machine now in use and previously patented, as will be seen by the above references, the stocking was knit with an open seam; the needles, therefor, being ranged on a portion of the periphery of a wheel, standing up like cogs on a crown wheel; but the present improvement is for knitting the stocking with a closed seam, and the nature of the improvement will be understood by reference to the claim which is in the following words, viz:—

“Having thus fully described the manner in which I construct my knitting machine, what I claim therein as constituting my invention, and desire to secure by letters patent, is the employment of an endless chain of hooks, or turning needles, upon which the loops, or stitches, are to be received, which chain is so constructed as that it may be lengthened or shortened at pleasure, for the purpose of widening or narrowing in the process of knitting. The hooks, or turning needles, used by me are grooved on their upper surface, and are otherwise constructed in a manner similar to those used in the machines where the stockings are knit open. I do not, therefore, make any claim to these, or to the apparatus by which the yarn is lifted, tramped, or otherwise operated upon, but confine my claim to the endless chain, constructed and operating in the manner, and for the purpose set forth.”

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35. For an improvement in the *Alarm for protection against Thieves*; Lester E. Denison, Saybrook, Middlesex county, Connecticut, October 22.

The improvement is applied to a money drawer, and consists of an

inclined plate, or ledge, on the bottom of a drawer, which, as the drawer is pulled out, actuates a lever which acts on a sliding plate that is connected, by means of rods and bell cranks, to a plate, called by the patentee a segment plate—this plate is hung on a joint pin and has a weight suspended to it at one end, whilst the other end catches on to the crank handle of an alarm and prevents it from ringing. The object of this arrangement is to disengage the segment plate from the crank of the alarm when the drawer is pulled out by any one not acquainted with the arrangement.

The claim is to the "combination and arrangement of the oblique plate, or ledge, on the bottom of the money drawer; with the vertical lever, horizontal plate, rods, bell crank, and segment plate for springing the alarm when the money drawer is moved."

36. For a machine for *Hewing Plough Beams*, and which is applicable also to other purposes; Draper Ruggles, Joel Nourse, and John C. Mason, Assignees of Elbridge G. Mathews, Worcester, Massachusetts, October 22.

The hewing is performed by means of gouges affixed to the face of a wheel towards the edge thereof. The piece of timber to be hewed is placed on to a sliding carriage, which is put in motion by the machinery in any known manner. A pattern is fastened on the upper side of the timber, with the edge of the form desired placed towards the cutter wheel. The formed edge of the pattern, as the carriage moves along, is pressed against a permanent guide by a weighted slide having a roller on that end of it which presses against the pattern. The piece of timber is protected from the cutters on the ascending side by a guard piece.

The claim is to the "arrangement by which a timber to be hewed is presented to, and guided along before, the cutters, in such manner as that the cutters act upon and hew the side of the timber according to a board or edge pattern, in conformity with any desirable curve or curves given to the edge of the pattern, as above described, or in any manner analogous thereto."

37. For a *Machine for Planing and Forming Ivory Comb Plates*; Julius Pratt, Ferner Bush, Aaron Pratt, and Zena K. Murdock, of Meriden, Connecticut, George Read, Alphas Starkey, George Spencer, and John C. Rogers, of Saybrook, Connecticut, Assignees of William M. Fowler, North Branford, New Haven county, Connecticut, October 23.

This machine consists of an annular plate, with teeth on the inner periphery thereof, attached to the edge of a hollow cylinder, connected with a shaft by a funnel shaped casing. The plates of ivory previously prepared in the rough, are presented by means of a pair of feed rollers, curved longitudinally to correspond with the curve of the cutter, ring, or plate. Two spring guides of the proper curvature

are placed in front of the feed rollers to insure the presentation of the plates in a proper manner to the rotating cutters.

Claim.—“I do not claim as my invention a circular cutter with teeth on the inner edge of the circle merely, nor do I claim merely the mode of feeding by rollers, but I do claim as my invention the application of a circular cutter having a diameter calculated to give the proper curve for planing and fashioning comb plates, in combination with the mode of feeding, or bringing plates to the operation of the cutter, substantially in the manner as above described.”

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38. For an improvement in the *Rotary Temple for Looms*; George Draper, Palmer, Hampden county, Massachusetts, October 28.

The patentee says.—“The main difficulty with the rotary temple now in use, consists in the construction of the wheel which is provided with only one set, or row, of oblique teeth, as by this arrangement the teeth must necessarily run constantly on the same thread, which has a tendency, in weaving thin fabrics, to crowd the threads too much to the selvage of the cloth, and by so doing, leave an open track where the teeth have passed.”

The improvement claimed is for the employment of two rows of teeth instead of one, the teeth in one row being opposite to the spaces between the teeth in the other row.

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39. For an improvement in the *Machine for Cleaning Wool from Burs, and Ginning Cotton*; Milton D. Whipple, East Douglass, Worcester county, Massachusetts, October 28.

The wool or cotton is fed into the machine by an endless apron, and feed rollers, it is then taken by the toothed cylinder and carried to a doffing cylinder which has a vibratory motion. This doffing cylinder has upon it one or two steel plates running its whole length, with teeth on one or both edges, about a tenth of an inch apart; they are brought to an edge from the under side, and they are still further raised from the surface of the cylinder by placing strips of paper or past-board under them. When the wool or cotton is taken from the toothed roller by the teeth on this vibrating cylinder, or doffer, it is stripped of the burs, or seeds, by a toothed plate, similar to those on the cylinder, attached to a guard plate above the cylinder.

The claim is to the “manner of applying and using the vibrating doffer, with its comb plates, constructed and operating as herein described, in combination with the toothed guard plate, as described; and this I claim whether the respective parts be formed exactly as herein represented, or in any other which is substantially the same, producing a like result by analogous means.”

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40. For an improvement in the *Machine for Cutting Shingles*; Miles R. Payne, Andersontown, Madison county, Louisiana, October 30.

This patent is for an improvement on such machines as cut the shingles from a bolt by means of a knife, or knives, attached to a gate



which slides horizontally, and consists in the employment of two sliding dogs which hold the bolt whilst the knife, or knives, is cutting. These dogs are held against the bolt by means of weights, and they are pushed back by a cam piece on each side of the sliding gate.

The claim is confined to the sliding dogs in combination with the cams on the side of the gate.

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41. For an improvement in *Gaiter Boots*; John H. Duport and Theodore Hyatt, city of New York, October 30.

This improvement consists in a peculiar mode of making the spring gores employed in gaiter boots instead of lacings. These spring gores may be made of the same material with the boot, the gore being stitched, and shirred, so as to receive strips of India rubber, which render the gore elastic throughout. The strips of India rubber being attached at their ends, and operating like the wire springs of suspenders, &c.

After disclaiming the mere making of boots with spring gores, and with India rubber springs having shirred coverings, the patentees limit their claim to "gaiter boots made elastic by being constructed with an elastic gore, or gores, made from the combination of shirred materials and India rubber springs, substantially as described."

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42. For a *Machine for Cutting Cork*; Charles R. Macy, Hyde Park, New York, October 31.

The pieces of cork, called blocks, cut into proper lengths, are held between two revolving spindles which grip them, and as they revolve, the cork is cut round by a revolving cutter wheel, the arbor of which is horizontal and has its bearings in a sliding frame. This frame rests upon two cams, on a shaft parallel to, and under the shaft of the cutter wheel, the cams being of such form as that at the commencement of each operation the frame and knife will be lifted up, and cause the edge of the cutter wheel to approach the piece of cork to be cut, and when the cork has been cut, the frame and cutter wheel are let down to allow the revolving gripes to receive another block. The edge of the cutter wheel is kept sharp during the operation, by means of two rotary disks, one acting on each face. The faces of these disks are covered with leather, and emery, or any other substance which will give an edge. As the cutter wheel revolves, to cut the cork, every part of its edge is brought around to these grinding disks. The blocks are fed in through a box, from which they are taken by a jaw which slides forward and places them between the gripes of the revolving spindles.

The claim is to the "combination of the rotary cutter wheels with the sharpening rotary disks, one on each face of the rotary cutter for the purpose and in the manner described.

"Secondly, to the method of moving the rotary cutter wheel up and down at the commencement and end of every operation by means of

the sliding frame, acted upon by the cams, for the purpose and in the manner described.

"And thirdly, to the method of feeding the machine with the block by means of the slide and jaw in combination with the receiving box and spindles as herein described."

The attempts at cutting corks by machinery have been numerous, and have uniformly proved failures; not that corks have not been cut by machinery, but because they have not been so well cut as by hand, and because the preparing and assorting of the blocks to be cut by the machine have required a degree of care and attention which are not repaid by the result.

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43. For *Clearing Snow from Railroads*; Joseph H. Moore, Worcester, and Benjamin Woodworth, Boston, Massachusetts, October 31.

This snow clearer consists of a drum having plates attached thereto spirally, from the middle towards each end, forming right and left screws of any desired number of threads, the depth of which will depend upon the breadth of the plates. This drum is situated in front of, and receives motion from a locomotive engine, and as it revolves and travels forward, the spiral plates take the snow and discharge it on each side of the track.

The patentees say, "our invention consists of the cylinder, or drum, with its shaft as above described, with the spiral plates, or snow clearers, constructed and attached to the drum, with a crank, or gear, wheel for driving or propelling the machine, as described, in connexion with a railroad engine for the purpose described."

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44. For a *Process of Preparing Tallow for the Manufacture of Candles*; John Kirkman, New York city, October 31, antidedated July 2, 1840.

This process is for preparing tallow for hard candles by separating the oil, or elaine, therefrom without pressing. The apparatus used consists of a cask, with a partition, or false bottom, pierced with small holes, and placed within a short distance of its bottom. Sufficient water is to be put into the cask to cover the false bottom; and the tallow, after it has been boiled and settled in the usual way, is poured into the vessel whilst hot; and after being kept therein, at a proper temperature, for about twenty-four hours, it begins to seed, or grain; a cock in the cask, below the false bottom, is then opened which allows the water and also the oil to run out, the tallow remaining above the false bottom. The tallow thus prepared, we are told by the patentee, will make hard candles possessing all the qualities of those made from pressed tallow.

The claim is to the "method of separating the oily part of the tallow by means of setting the mass of tallow over water as above described, and drawing off the water and oil from the bottom."

45. For a machine for *Separating Garlic from Wheat*; Jona F. Barrett, North Granville, Washington county, New York, October 31.

The patentee says—"The principle upon which my machine operates is that of pressure, and of the friction of the grains against each other. The two being combined in such a manner as to produce the crushing of the garlic, smut, white caps, and other foreign matter by their attrition against the grain, and not by being rubbed against any thing of the nature of graters, points, or other asperities, on the interior of the machine, in which the agitation is effected. The pressure may be made in various ways, as by a high column of grain contained in a cylinder, or shaft, above the agitators, and pressing upon that portion which is subjected to friction by the agitators, or the grain may be pressed upon by a revolving or a stationary plate resting upon its surface.

"The grain to be cleansed is fed into a cylindrical vessel, within which it is subjected to pressure under, and by means of, a revolving plate, or disk, of weight sufficient to cause the garlic and all other substances less hard than the grain itself to be crushed by their attrition against the grain which is kept in motion by means of projecting pieces, which I call agitators, affixed to the bottom of the cylindrical vessel, and to the under side of the revolving plate, or disk."

Claim.—"Having thus fully described the nature of my invention and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is the acting upon the grain by compression and attrition combined with a force sufficient to crush the garlic and other foreign matter, without breaking the grain itself, the same being effected in the manner herein set forth; that is to say by making pressure upon the grain subjected to attrition, either by means of a plate constructed as herein described, and revolving above it, and carrying agitators which co-operate with fixed agitators, as set forth; or by making the pressure by means of a column of the grain of sufficient height to effect the purpose, when combined with its agitation, by means of revolving and fixed agitators, arranged and operating substantially as set forth."

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46. For a method of *Protecting Trees from Canker Worms*; Daniel Newhall, Lynn, Essex county, Massachusetts, October 31.

This patent is for an improvement on the mode now in use of destroying the grub, and which consists of a trough placed around the tree, and containing oil, or other liquid, which is deleterious to the grub. The improvement is in placing a box over the trough, the edges of which extend below it, to prevent the dust and leaves from settling in the oil, or other liquid, and the wind from blowing it out. One or two of the sides of this box are hinged so as to give admission at the trough.

The claim is to the addition of "a roof or casing constructed as



described, in combination with a metallic trough for oil or other liquid suited to the object."

This seems to be a small affair for a patent; the placing of a lid, cover, or roof, to a trough, partakes about as little of substantial invention as could well be, to claim the sanction of the seal of the patent office.

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SPECIFICATIONS OF AMERICAN PATENTS.

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*Specification of a Patent for an Improvement in the Manufacturing of Cloths of Wool, or Wool and Silk. Granted to REUBEN DANIELS, Woodstock, Windsor county, Vermont, October 8th, 1840.*

To all to whom it may concern: Be it known that I, Reuben Daniels, of Woodstock, Windsor county, Vermont, have invented an improvement in the manufacturing of cloths of various kinds including those in which wool is the only material employed, and those into the manufacturing of which wool enters as an essential part thereof, and I do hereby declare that the following is a full and exact description of my new manufacture.

The improvement consists in the remanufacture of wool into cloths of various kinds, such as broad cloths, kerseymeres, sattinets, and others of a similar character, and into cloths in which the warp consists of cotton, silk, or other material, and the filling in whole or in part, of wool; or of cloths in which the cotton, silk and wool are mixed together, and are carded and spun in their combined state; all of which I have successfully essayed. The wool so remanufactured I obtain by taking worn out woollen goods of various kinds, and also worn out silks, and reducing them to their original state by means of machinery which I have invented for that purpose (and for which I have made application for letters patent, simultaneously with the present application) or reduced by means of any other machinery which will produce said fibres of wool in a state fit for remanufacturing into yarn and cloth.

I sometimes take such restored wool, and card, spin, and weave it, alone, or I mix it with fresh wool in proportion of, at least, one-sixth part of the restored wool to five-sixths of the fresh wool, and I, in either case, thereby obtain yarn or cloth equal in all respects to that which can be obtained from either fresh, or new, wool of the same degree of fineness, a result not heretofore obtained, and by which I am enabled to produce such cloth, and sell it at a price considerably lower than that of cloth consisting entirely of fresh, or new, wool; as it is a fact which I have established by full experience that the reproduced fibres of wool may be obtained from the worn out woollen goods, pound for pound, at a very trifling cost.

What I claim as my invention, or discovery, and desire to secure by letters, is the employment of wool and of silk obtained by the re-

ducing into the fibrous state of worn out woollen or silk goods, so as to produce new fabrics, by the operations of spinning and weaving, equal in all respects to those obtained from new, or fresh wool, said reproduced fibre to be used either alone or in proportion to that of the fresh wool of not less than one-sixth part.

REUBEN DANIELS.

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## English Patents.

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*Specification of a Patent granted to HENRY ELKINGTON, of Birmingham, in the county of Warwick, for his invention of Improvements in Covering, or Coating, of Certain Metals with Platina; and also Improvements in Gilding Certain Metals, and in Apparatus used in such Processes.*—Sealed 17th February, 1837.

These improvements apply to the coating of metals with platina and gold, which is a new mode of gilding, intended to supersede the old practice of employing an amalgam of mercury and gold.

Platina, in the first instance, is to be dissolved in nitromuriatic acid. About ten ounces of nitric acid, and the same of muriatic acid, is required to dissolve one ounce of platina; and the combined acids must be kept at a gentle heat until the dissolution has been completely effected.

When this has been done, the liquid is to be evaporated to about half its quantity, and then three quarts of water added to it, with three ounces of bi-carbonate of soda, which is to be boiled until the soda is dissolved, and then one pound of bi-carbonate of potash added; after which the whole must be boiled together for half an hour.

A slip of brass, or copper, put into this solution, will experience little or no change in its appearance; but if a solution of gold be added to it, in proportions of from one to five pennyweights of gold to the quantity of the solution, then the gold and platina will attach themselves to the metal.

While this process is going on, the solution must be kept boiling, and the effect will be in proportion to the quantity of gold employed, and the continuance of the boiling. At first, the surface of the metal under operation, will appear of a bronze colour, but it will ultimately assume that of fine gold.

Another mode of gilding proposed, is by first coating the articles with platina in a metallic state, and then submitting them to immersion and boiling in the solution of gold. The effect will be the same nearly; the process only differing.

Under this head of the invention, the patentee claims the exclusive use of carbonate of potash, or soda, in solution with platina and gold, for the purpose of gilding the surfaces of metals.

An inferior mode of gilding is also mentioned, which is effected by boiling the articles in a solution of mercury, potash and gold; but this is only employed for articles of a less costly quality, and is substitut-

ed for an amalgam of mercury and gold, upon which it is an improvement, as a more ready, cheaper, and better mode of gilding.

The articles of jewelry thus gilt, may be coloured and lacquered, in the old way; that is, by the known processes, in which the patentee does not claim any novelty.

In order to preserve the platina, and gold, which may remain in solution after the gilding operation is done, it is proposed to evaporate the solution in a close vessel, by means of a vacuum, produced by an air pump. The particular form of this vessel, however, is unimportant, so long as it will effect the object proposed; which is to allow the metallic residuum to be preserved, and made capable of being employed for a future operation of gilding.

London Journal of Arts and Sciences, May, 1841.

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*Specification of a Patent granted to BERNARD AUBE, of the city of London, for Improvements in the Preparation of Wool for the Manufacture of Woolen and other Stuffs, and in the process of Obtaining the Materials to be used for that purpose.*—[Sealed May 7th, 1840.]

In preparing wool for the manufacture of woollen and other stuffs, it is well known that large quantities of oil are used to facilitate the working of the wool in the preparatory processes through which it passes, and the descriptions of oil used are expensive. Now the objects of my invention are to use oleic acid, which is comparatively a cheap article of manufacture, possessing properties peculiarly adapted to the preparatory processes through which wool passes; and also by washing wool containing oleic acid in an alkaline solution, there will be a saponaceous product obtained applicable to the fulling of woollen cloth, which I prefer to oleic acid, following the ordinary processes by which the oleic acid would be washed away, in like manner to what is generally the case when washing and pressing out the oils used, and as heretofore practised.

I would here remark, that oleic acid is a fluid well known, and is the fluid product or acid obtained from fatty matters, when the two acids composing fatty matters are separated, and such separation is now largely practised by persons engaged in the manufacture of what are called stearine candles, and the various processes for separating the acids are well known, and form no part of my invention; and oleic acid may be purchased in large quantities, particularly from manufacturers of stearine candles. And in carrying out my invention, in place of using oils, I use such fatty acid called oleic, or tallow oil, and using the same intimately with the wool in a similar manner to that usually resorted to when employing the oils now used; and the workmen will judge by the working of the wool whether he has applied sufficient oleic acid or not, in the manner as he now judges whether he has applied sufficient oil, by the manner in which the wool under operation works, because it is well known that different wools require different quantities of oil, and therefore no exact quan-



tities can be given, and different workmen use more or less oil in working the same descriptions of wool. All that will therefore be necessary to state is, that in using oleic acid for the oils now employed, the workmen will judge by the freedom with which he can work the wool, and will use more or less of the oleic acid. When removing the oleic acid from the wool or fabrics made therefrom, it may be accomplished by the same means as heretofore practiced when the oils now employed have been used; but I prefer that the water used should have an alkali dissolved therein, so as to convert the oleic acid into a saponaceous product, which will be found particularly useful for fulling woolen cloths in place of soap; and for this purpose I dissolve about one half by weight of soda of commerce (which is the alkali I prefer, but I do not confine myself to that alkali,) of the weight of the oleic acid known to have been used in preparing the quantity of wool which is now to be treated, and such quantity of alkali is to be dissolved in a quantity of water about twice the weight of the wool to be cleansed. Although I am thus particular in giving quantities, I do not confine myself thereto, as they may be varied, but the quantities stated are those which I have used. By thus using an alkaline solution as the material for washing out the oleic acid from the wool, in addition to getting rid of the oleic acid, I also, as above stated, obtain a product very suitable for fulling woolen cloths.

Having thus described the nature of my invention, I would have it understood that what I claim is, first, the mode of preparing wool by the use of oleic acid in such processes.

And secondly, I claim the mode of preparing wool by the use of oleic acid, when combined with the removing it therefrom by means of an alkaline process, as described.

Repertory of Patent Inventions, July, 1841.

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*Specification of a Patent granted to THOMAS MACGAURAN, of the County of Middlesex, for Improvements in the Manufacture of Paper from a Material not hitherto so employed.*—[Sealed August 26th, 1840.]

The invention consists in manufacturing paper from the hop-bine, which may be used as a substitute for the pulp of linen or other rags, or it may be used mixed with linen rags, or any other suitable material, if desired.

I will now describe the mode of preparing the bine, in order to render it suitable for the manufacture of fine paper. I take the bine after the hops are removed, and after bruising the stalk by passing it through rollers, or by any of the ordinary means (used for bruising hemp and other fibrous plants,) and cut it into small pieces of one or two inches long. I then place these pieces to soak in rain or river water, where they should be allowed to remain immersed in water for about twenty-four hours; they are then to be well washed, without breaking the pieces, in the ordinary washing engine (that being well known to paper makers, I have not thought it necessary to des-

cribe it,) this washing should continue until the water passes away perfectly clear; during this part of the process the roller should not touch the plate. When it is well washed I stop the water from passing through, and let down the roller on to the plate, and beat the bine until no splints or white chips appear. It is then to be taken to a press and to be subjected to pressure until nearly dry. It is then to be put into a cistern, which I prefer should be of stone, or lead, containing chloride of lime; and I use about 10 lbs. of chloride of lime to 100 lbs. of bine, in which it should be immersed for twenty-four hours. It is afterwards cleansed from the chloride of lime by a stream of water passing through the cistern. It is then to be subjected to the operation of an ordinary beating engine. The rougher the surface of the blade and plate of such engine is, the better. It is then trituated and beaten into an impalpable pulp. I take this pulp and submit it to the same process as just described. It will then be in a fit state to be manufactured into fine paper. In making coarse paper the process is the same as above described, with the omission of that part of it which applies to the reducing it to an impalpable pulp, that not being necessary. The paper may be bleached by any of the ordinary well known means.

Having thus described the nature of the invention and the manner of performing the same, I would remark that I do not confine myself to the mode herein described of preparing the bine, though I believe it to be the best for the purpose; but what I claim as this invention is the manufacturing paper from the hop-bine, either by itself, as a substitute for linen or other rags, or it may be mixed with them, or other suitable material, for the purpose of making paper.

*Ibid.*

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### **Progress of Practical & Theoretical Mechanics & Chemistry.**

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*Upon the Application and Use of Auxiliary Steam Power, for the purpose of shortening the time occupied by Sailing Ships, upon distant voyages. By SAMUEL SEAWARD, M. Inst. C. E.*

But few years have elapsed since the possibility of propelling vessels by the power of steam was treated as a chimera; and although the practicability of its application for short voyages has been successfully demonstrated, by the numerous vessels plying between this country and the continent, it is but of very recent date that its employment for long sea voyages has been adopted. The weight of the powerful machinery and the fuel, and the consequent loss of space for cargo, together with many other circumstances attendant on the present construction of steam vessels, induced the author (who received the education of a seaman, and has since had extensive practice as an engineer) to believe that a more efficient mode of employing steam power, for long sea voyages, might be adopted.

Notwithstanding the great improvements which have taken place in the construction of steam vessels, and their machinery, it would

appear that the duration of the voyage ought not to exceed twenty days, after which time a fresh supply of fuel becomes necessary; hence, steam has rarely been adopted for very long voyages. The reason of this limit to the duration of the voyage of a steam vessel, as at present equipped, is that an increase of power does not produce a corresponding increase of speed, while the weight of machinery increases in proportion to the power employed, and in some cases exceeds it; for instance, small engines, with the water in the boilers, generally weigh about one ton per horse power, while in some large engines the ratio is nearly twenty-five cwt. per horse power.

A quadruple increase of power will not produce double the original velocity in a steam ship, although, in theory, such is assumed to be the case; for, as the weight is more than double, the immersed sectional area becomes greater, and a still further increase of power is necessary. It has been shown by experience, that if a vessel, with a given power, is propelled through the water at the rate of eight miles per hour, her speed cannot be doubled, even though the power be multiplied twelve times, and the entire hold of the vessel be occupied as an engine room.

The weight of fuel is also in direct proportion to the size of the engines; so that taking for example, two vessels of two hundred and of four hundred horses power respectively—that of the higher power will have to carry nearly double the weight, both of fuel and of engines, and it is still questionable whether the increased force will propel the one ship more than one and a half miles per hour faster than the other.

The space occupied by the engines and fuel, in the most valuable part of the ship, is also an important consideration: neither the “*President*” nor “*British Queen*” steamer, although of two thousand tons measurement, is capable of carrying more than five hundred tons of cargo, when the fuel is on board.

The author then examines the question of employing too much power in a steam vessel, and refers to the “*Liverpool*,” as an instance that such may be the fact. It appears that with the original dimensions of thirty feet ten inches beam, and engine power of four hundred and fifty horses, being a proportion of power to tonnage of about one to two, and one-fourth the vessel was immersed four feet beyond the calculated water line, and a decided failure was the natural consequence; but when the breadth of beam was increased to thirty-seven feet, augmenting the capacity of four hundred tons, and giving the proportion of one horse power to three and three-fourths tons burthen, the performance of the engine and the speed of the vessel were both materially improved.

The “*Gem*,” Gravesend steamer, one hundred and forty-five feet long, by nineteen feet beam, had two engines of fifty horses power each; the speed was insufficient, being only twelve and a half miles through the water; but when the same engines were placed in the “*Ruby*,” which was one hundred and fifty feet long, and nineteen feet nine inches beam, the velocity of the latter vessel was thirteen and a half miles per hour. A pair of engines, of forty-five horses



power each, were then placed in the "Gem," without altering the vessel, and in consequence of the diminished weight and draught of water, her speed then nearly equalled that of the "Ruby."

The author does not condemn the application of considerable power for vessels, providing it can be employed without materially increasing the weight and the area of the immersed midship section. It appears that the length of a steam voyage, to be profitable, is at present limited to twenty days for the largest class of steamers; that we have about thirty others which can approach twelve days, while the majority cannot employ steam beyond eight days successively, without a fresh supply of fuel. It is evident, therefore, that more efficient means must be adopted for the general wants of commerce in our extended intercourse with the East and West Indies, the Pacific, Mexico, Brazil, Australia, and all the distant colonies, which now demand rapid communication with England.

The author refers to a pamphlet, published by him in 1827, entitled "Observations on the possibility of successfully employing Steam Power in Navigating Ships between this country and the East Indies by the Cape of Good Hope." He therein proposed that large square-rigged ships, of fifteen hundred to eighteen hundred tons measurement, should be fully equipped and constructed so as to sail ten or eleven miles per hour with a fair wind; that they should carry engines of small power, to assist the sails in light winds,—propel them at a moderate speed during calms,—work into and out of harbour, &c.,—and thus shorten those portions of the voyages wherein so much time was usually lost.

To all well built good sailing vessels, of four hundred tons and upwards, "auxiliary steam" is applicable. A steam engine of the necessary power, can, without inconvenience, be placed in such vessels, either on or between decks, so as to propel a ship at the rate of four to five nautical miles per hour in a calm, and for this speed a proportion of one horse power to twenty-five tons is amply sufficient. The practicability of applying this system to East Indiamen and other similar vessels, is then examined at length, and it is shewn that the ordinary speed of these ships under sail, is, before the wind, eleven to twelve miles per hour, and in a gale thirteen to fourteen miles per hour, which is greater by two or three miles per hour than that of any ordinary steam vessel when under sail, on account of the latter being impeded by the wheels trailing in the water, and the slightness of their masts, spars, and rigging. The auxiliary steam power might, therefore, be efficiently applied, either by using it alone, or in conjunction with the sails, so as to keep up a uniform speed, by which a great saving of time could be effected in a long voyage.

The conditions of sailing and steaming voyages to India, with the influence of the trade winds, are then examined, and the author proceeds to detail the experiments made by him, on board the "Vernon" Indiaman, which was the first sailing vessel that actually made a voyage out and home with "auxiliary steam."

The "Vernon," built in 1839, by the owner, Mr. Green, was one thousand tons burthen; the sailing speed was about twelve to thirteen

miles per hour in a fresh gale, and being from her frigate build well calculated for the experiment, it was determined to equip her with a condensing engine of thirty horses power, placed midships on the main deck, between the fore and main hatchways; the space occupied being twenty-four feet long by ten wide. The weight of the machinery was twenty-five tons, and it was so arranged that the motion was communicated direct from the piston cross-head, by two side rods, to the crank on the paddle shaft, placed immediately behind the lower end of the steam cylinder, which was horizontal. The wheels were fourteen feet diameter, projecting five feet, and were so constructed that the float boards could be raised to suit the draught of water of the ship; or they could be taken entirely away, if necessary, leaving the shafts projecting only eighteen inches beyond the sides. Under ordinary circumstances they were disconnected from the engine by a simple contrivance, consisting of a movable head, attached to the crank on the paddle shaft, by turning which, one quarter of a circle, the crank pin was liberated, and the wheels turned freely round. The "Vernon," thus equipped, having on board nine hundred tons of cargo, and sixty tons of coal, drew seventeen feet of water. In the first trial the speed of the vessel, under steam alone, was five and three-quarters nautical miles per hour, demonstrating how small a power is necessary for a moderate speed. She then started for Calcutta, and though the piston rod broke three times during the voyage, owing to a defect in one of the paddle shaft bearings, the passage was satisfactory. The details are given minutely, as are also those of the homeward voyage, which was performed from Calcutta to London in eighty-eight days, to which must be added seven days for necessary delay at the Cape, making a total of ninety-five days, which is the shortest passage on record. Great credit is given to Captain Denny for the judgment with which he used the auxiliary steam power, and the course taken by him, by which he was enabled to overcome the difficulties incidental to a first trial of so important a system. The success of the "Vernon," induced the immediate application of engine power to the "Earl Hardwick" Indiaman, and both these vessels are now on their voyage out to Calcutta.

For the purpose of demonstrating the ratio of power to velocity, a Table was also given showing the velocities of ships of different tonnage, having steam power of various ratios, deduced from upwards of one hundred experiments on large steam vessels.

It was shown, that an engine of thirty horses power would propel a ship of twelve hundred tons burthen, at the rate of four knots per hour, while three hundred horses power would only propel the same ship at the rate of ten and five-ninths knots per hour. Hence, ten times the power would only produce about two and a half times the speed.

The principal points in the paper were more fully dwelt upon, and, in answer to questions from some of the members, Mr. Seaward remarked, that no steamer in England had ever been propelled at more than fifteen geographical miles per hour, through still water.

In some of the Government mail packets, the engines and coals were the full cargo of the vessel. The table did not apply to vessels

overladen with power, for as the weight increased in the ratio of the power, so the immersed sectional area was augmented, and the lines of the vessel, which might be well calculated for speed when at a proper draught, became lines of retardation, and the engines did not work up to their proper speed, owing to the depth to which the paddle floats were immersed. For instance:—The wheels of the “British Queen” have been plunged between six and seven feet, instead of four feet, which was the calculated dip; the engines at the same time diminishing their speed so much as to reduce the effective power from five hundred horses to nearly three hundred horses.

The only advantageous way in which great power could be applied, would be by contriving to prevent the increase in the weight of the machinery and fuel, and those engineers would be most successful who could so apply the materials of construction, as to ensure strength without the usual corresponding increase of weight.

Mr. George Mills, from his experience as a ship-builder, at Glasgow, was enabled to confirm all that Mr. Seaward had advanced. On the Clyde, the employment of an excess of power in steam vessels had been carried to the greatest extent, without producing corresponding advantages, either for speed, or in a commercial point of view. It would appear that the same error had, to a certain degree, been committed on the Thames, but less than on the Clyde; for on the latter river there were vessels with nearly double the power, in proportion to the size, as compared with any vessel on the former river. He believed that on the Thames no vessel had so much as one horse power for each register ton, whereas on the Clyde, there were steamers of seventy to eighty tons register, having single engines, with cylinders of fifty-four inches diameter, which was more than one hundred horses power. It would appear that this application of extra power had only obtained a very moderate speed, while the great first outlay, with the commensurate current expenses, had reduced the commercial profit to the lowest point,—of this the proprietors alone could give any account; but as to the speed attained, he had seen three steamers of identical tonnage leave the Broomielaw at the same time, their engines being respectively of one hundred and ten, eighty, and sixty horses power; yet their speed was in the inverse ratio of their power: the vessel with the smallest engine arrived at Greenock first, the greater power second, and the greatest last. These remarks were only applicable to river boats. With regard to sea-going vessels, the system had not been carried to so serious an extent, yet with them the average proportion was about one horse power to two register tons, and some few reached as high as one horse to one and one-eighth of a ton.

As an example of an augmentation of power producing an opposite result from that which was intended, Mr. Mills mentioned two vessels called the “Tartar” and the “Rover,” built by him and his (then) partner, Mr. Charles Wood. They were each of about two hundred and twenty tons register, built from the same draught, and in every respect as similar as possible—except that the engines, which were by the same maker, were respectively of one hundred and seventy,



and one hundred and thirty horses power; yet whenever they worked together, the one with the smaller power proved herself the faster vessel, either in a calm, with the wind, or even against it. The "Achilles," Liverpool steamer, which lately had an addition of thirty feet to her length, and eighteen inches to her breadth, augmenting the tonnage about one-fifth, had improved her speed upwards of one mile per hour, although she carried a much heavier cargo than before.

He had built a vessel of five hundred and sixty tons register, with engines of one hundred and thirty horses power on board—a proportion of power to tonnage of one to four; the stowage for cargo was ample; the accommodation for passengers excellent. She drew little water, and her speed was much greater than vessels of double her power. Yet in spite of all this, the vessel could not find a purchaser, because the power was not nominally large.

It would be asked—why, with these and so many similar instances, such a system was continued? It was not likely that the engineers would complain of having orders for large engines; and there were certain dimensions prescribed for the vessel, to which the ship-builder was under the necessity of conforming.

The chief cause of mischief, however, was the fiat of the public. It was believed that a great power would remedy want of speed and all other evils, and it was found indispensable for ensuring the confidence of travellers. Hence, the shipowners, who depend upon the public for support, were obliged, against the conviction of their experience, to keep up the errors occasioned by ignorance.

The President observed, that the condemnation of large power should not be carried too far, as experience alone had produced the increase of weight, strength, and power, of the present engines, compared with those of the early steamers which were built, instancing the Halifax Packets (Cunard's,) which with their great power in proportion to tonnage, had performed their duties satisfactorily.

Mr. Mills explained that the Halifax Packets were built for the especial purpose of carrying the mails only, to perform the voyage in a given time,—about twelve days. The engines were built by Mr. Robert Napier, after the model of those of the "Great Western," which used their steam expansively; similar provisions had been made in the Halifax Packets, but the expansion valves were seldom used.

Mr. Field agreed with the principal part of Mr. Seaward's paper, but he would prevent an erroneous conception of the term *overpowering* a steamer. A vessel could not have too much power, provided that power could be advantageously applied, without causing too deep an immersion. A good result could be produced only by keeping a proper proportion between the machinery, the vessel, and the paddle wheels, and immersing the hull of the steamer only as deep as the true lines of draught.

Mr. Vignoles observed, that in this country the reputation of engineers depended upon the commercial success of the works they engaged in. An erroneous public opinion might have influence at present; but if the engineer and ship builder would determine to break these trammels, and produce such vessels as should force conviction upon

the public mind by the speed attained, and show the proprietors the consequent commercial advantage, the present system would soon be abandoned.

Mr. Parkes eulogized Mr. Seaward's candour in describing the errors in the first construction of the engine on board the *Vernon*; more was frequently to be learned from failures than from successful efforts, and no communications to the Institution would be so useful as those which gave accounts of defective design or construction, with the details of the methods adopted for remedying the defects. He directed attention to the performances of the "*Great Western*" steam ship, which at least equalled those of the *Halifax Packets*, without the disadvantages of being unable to carry cargo, or of shipping so much sea, when the weather was foul. The important feature of economy of fuel on board the "*Great Western*" might be in part attributed to the use of steam expansively. It was very desirable that the Institution should possess very full drawings and a description of the "*Great Western*," so as to be enabled to compare them with those of the *Halifax Packets*, which had been promised by Mr. George Mills. He would impress upon manufacturers of marine engines the necessity of adopting a correct and uniform nomenclature of the power placed on board steam vessels. The nominal selling power did not accord with any calculation.

Mr. Field believed the Table of Velocities calculated by Mr. Seaward to be very nearly accurate. The speed of the "*Great Western*," when loaded to her proper draught, had been as high as  $13\frac{3}{10}$ th miles through still water. There was an error in the alleged speed of *Cunard's* vessels; they reached *Halifax* in ten days, *Boston* in three more, and then had still one day's voyage to *New York*. The average duration of the voyages of the "*Great Western*," was about fourteen days and a half. If two hundred tons were deducted from the tonnage of the "*Great Western*" for cargo and the accommodation for the passengers, she would then be similar to the *Halifax Packets*. The engines of the "*Great Western*" were nominally estimated at four hundred horses power, and the average consumption of fuel was twenty-six tons every twenty-four hours.

During the discussion, Mr. Cubitt had calculated the following Table, showing the rates of velocity which would be attained by substituting engine power, with its consequent weight of one ton per horse power, for cargo, so as to preserve the draught of water the same in all cases.

Mr. Seaward remarked, that his Table of power and velocities was corroborated by Mr. Cubitt's—the practical results verified both. The great difference between the "*Great Western*" and the *Halifax Packets*, consisted in the better adaptation of weight and power to tonnage, and the more economical consumption of fuel of the former over the latter—the one carrying cargo and passengers, the other only the engines and fuel, yet the "*Great Western*" traveled farther with the same quantity of fuel.

*Table showing the power required to obtain various rates of speed in a steam vessel, where the total weight of cargo and engines remains in all cases the same, and in which, with a power of 30 horses, a speed of five miles per hour is obtained; and the total weight carried being in all cases 1000 tons, and the engines weighing one ton per horse power.*

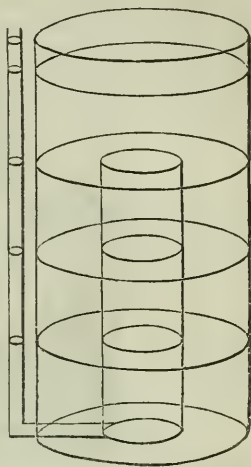
| Weight of Cargo. | Weight and Power in Tons and Horse Power. | Relative Speed. | Speed in Miles per hour. |
|------------------|-------------------------------------------|-----------------|--------------------------|
| 970              | 30                                        | $5\sqrt[3]{1}$  | 5.                       |
| 940              | 60                                        | $5\sqrt[3]{2}$  | 6.299                    |
| 910              | 90                                        | $5\sqrt[3]{3}$  | 7.211                    |
| 880              | 120                                       | $5\sqrt[3]{4}$  | 7.937                    |
| 850              | 150                                       | $5\sqrt[3]{5}$  | 8.549                    |
| 820              | 180                                       | $5\sqrt[3]{6}$  | 9.085                    |
| 790              | 210                                       | $5\sqrt[3]{7}$  | 9.564                    |
| 760              | 240                                       | $5\sqrt[3]{8}$  | 10.                      |
| 730              | 270                                       | $5\sqrt[3]{9}$  | 10.4                     |
| 700              | 300                                       | $5\sqrt[3]{10}$ | 10.772                   |
| 670              | 330                                       | $5\sqrt[3]{11}$ | 11.119                   |
| 640              | 360                                       | $5\sqrt[3]{12}$ | 11.487                   |
| 610              | 390                                       | $5\sqrt[3]{13}$ | 11.756                   |
| 580              | 420                                       | $5\sqrt[3]{14}$ | 12.050                   |
| 550              | 450                                       | $5\sqrt[3]{15}$ | 12.331                   |
| 520              | 480                                       | $5\sqrt[3]{16}$ | 12.599                   |
| 490              | 510                                       | $5\sqrt[3]{17}$ | 12.856                   |
| 460              | 540                                       | $5\sqrt[3]{18}$ | 13.103                   |
| 430              | 570                                       | $5\sqrt[3]{19}$ | 13.34                    |
| 400              | 600                                       | $5\sqrt[3]{20}$ | 13.572                   |
| 370              | 630                                       | $5\sqrt[3]{21}$ | 13.794                   |
| 340              | 660                                       | $5\sqrt[3]{22}$ | 14.01                    |
| 310              | 690                                       | $5\sqrt[3]{23}$ | 14.219                   |
| 280              | 720                                       | $5\sqrt[3]{24}$ | 14.422                   |
| 250              | 750                                       | $5\sqrt[3]{25}$ | 14.62                    |
| 220              | 780                                       | $5\sqrt[3]{26}$ | 14.812                   |
| 190              | 810                                       | $5\sqrt[3]{27}$ | 15.                      |
| 160              | 840                                       | $5\sqrt[3]{28}$ | 15.182                   |
| 130              | 870                                       | $5\sqrt[3]{29}$ | 15.3615                  |
| 100              | 900                                       | $5\sqrt[3]{30}$ | 15.535                   |
| 70               | 930                                       | $5\sqrt[3]{31}$ | 15.706                   |
| 40               | 960                                       | $5\sqrt[3]{32}$ | 15.854                   |
| 10               | 990                                       | $5\sqrt[3]{33}$ | 16.037                   |

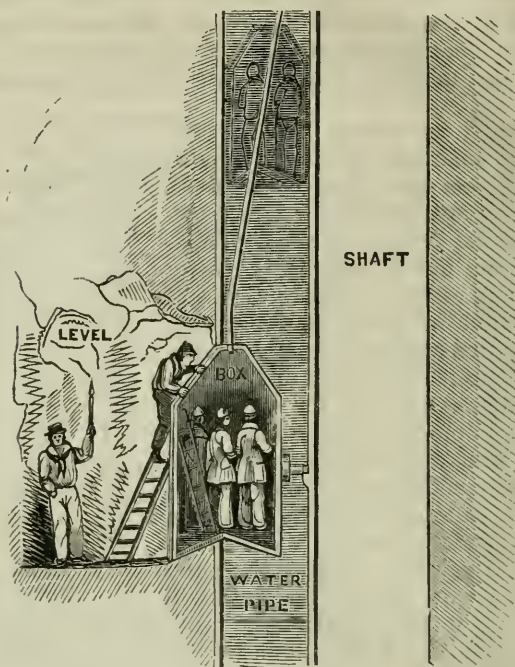


*Simple Illustration of the Doctrine of Latent Heat.* By DR. DALTON.

The following simple illustration of the doctrine of latent heat by Dr. Dalton will enable those who are not familiar with the operations of heat to form a tolerably correct notion of the phenomenon in question:

The liquid and its vapour may be considered as two reservoirs of caloric, capable of holding different quantities of that fluid. Let the figure represent to us such an arrangement; the internal cylinder of smaller capacity, the external one of enlarged capacity surrounding and extending far above it, and a small open tube of glass, communicating freely at the bottom with the internal cylinder. Let us now conceive the water to be poured into the internal cylinder, the water will manifestly flow into the slender tube till it stand on the same level in the tube as in the cylinder. If any additional quantity be now poured into the internal cylinder, the rise of water in the slender glass tube will serve as an index of the quantity of added fluid; and when it is filled to the top, the fluid will stand at the height marked  $212^{\circ}$ , and will still be a correct index of the addition of fluid. But if more water be now added to it, it will not make its appearance in the slender tube, but will simply overflow from the internal cylinder over into that of enlarged capacity, so that while a large quantity is passing into the vessel and gradually filling it up to  $212^{\circ}$ , no additional rise takes place until the whole of the outer cylinder becomes filled to that point, after which any further addition will again become sensible, by a corresponding rise in the tube. This process is in precise analogy to the succession of circumstances in heating a liquid, and converting it into steam. The internal cylinder represents the liquid, the external one the vapour of greater capacity, and the slender glass tube at the side the thermometer placed in communication with them. When heat flows into the liquid, it passes equally into the thermometer; and each increment of the one produces an equal increment in the other, until the liquid reaches the limit of its capacity, when it suddenly begins to enlarge its bulk and take the form of steam; but the quantity of heat required to fill up this enlarged capacity is so great, as to require about  $5\frac{1}{2}$  times as much to fill it as was contained in the whole liquid before, so that all this time the thermometer is standing still, and it is not until the whole of the steam is thus supplied with  $212^{\circ}$  of caloric, that the thermometer will begin to show any further elevation; after which, any increment of heat thrown into the steam will make its appearance on the thermometer, and proceed as formerly, by simultaneous increments.



*New Plan for Raising and Lowering Miners.*

A cast-iron, or other, tube of sufficient strength, filled with water, is to be placed in the shaft, and extending from the bottom to the top of the mine; in this air-tight boxes are to be immersed. For ascending, of course, they must be a little lighter than the water, and, for descending, the admission of a small quantity of water will be sufficient, of course depending upon the velocity wished for. At whatever place it is required to stop, whether at the middle or at the bottom, a lock must be provided, into which these air-tight subaqueous miners' omnibuses may be conveyed; and, communication being cut off from the upright pipe, the miners may, on opening a door, disembark in safety. If it should be found that there was not sufficient air in the box for the ascent or descent, a flexible air-tube might be attached to it, which, by having a suitable weight to it, might travel along an inclined piece of ground near the mouth of the shaft. As there would always be some little loss of water in the opening and shutting of the locks when ascending, instead of admitting water from the main tube, before opening communication, the lock should be filled, from some small running in the mine at that level, and so save extra pumping. In these operations there would be no expensive machinery, no power to maintain—the opening and shutting of the locks would be the only things to attend to.

CAROLUS.

*"An account of some experiments to determine the force necessary to punch holes through plates of wrought Iron and Copper."* By Joseph Colthurst. Read before the Lond. Inst. Civil Engrs.

These experiments were performed with a cast-iron lever, 11 feet long, multiplying the strain ten times, with a screw adjustment at the head, and a counterpoise.

The sheets of iron and copper which were experimented upon were placed between two perforated steel plates, and the punch, the nipple of which was perfectly flat on the face, being inserted into a hole in the upper plate, was driven through by the pressure of the lever.

The average results of the several experiments which are given in a detailed tabular form, show that—

The power required to force a punch—

| Inch diam.       | Through an iron plate | Inch thick. |               |
|------------------|-----------------------|-------------|---------------|
| 0.50             | ditto                 | 0.08        | is 6,025lbs.  |
| 0.50             | ditto                 | 0.17        | is 11,950lbs. |
| 0.50             | ditto                 | 0.24        | is 17,100lbs. |
| Through a copper |                       |             |               |
| 0.50             | plate.                | 0.08        | is 3,983lbs.  |
| 0.50             | ditto                 | 0.17        | is 7,883lbs.  |

Hence it is evident, that the force necessary to punch holes of different diameters through metals of various thicknesses, is directly as the diameter of the holes and the thickness of the metal.

A simple rule for determining the force required for punching, may thus be deduced.

Taking one inch diameter, and one inch in thickness, as the units of calculation, it is shown that 150,000 is the constant number for wrought iron plates, and 96,000 for copper plates.

Multiply the constant number by the given diameter in inches, and by the thickness in inches; the product is the pressure in pounds, which will be required to punch a hole of a given diameter, through a plate of a given thickness.

It was observed that duration of pressure lessened considerably the ultimate force necessary to punch through metal, and that the use of oil on the punch reduced the pressure about eight per cent.

Mining Journ.

### *New Shoe for Horses.*

A Frenchman of the name of Jony, who is at present resident in Poland, has invented a new method of shoeing horses, for which the Emperor has awarded him 50,000 rubles, besides an exclusive patent. Jony covers the entire hoof with iron, and the base of his shoe, or as it is called, the sandal, is perfectly smooth. This method of his is being adopted in all parts of Russia. It requires neither nail nor screw; it is extremely cheap; and has the important characteristic of great lightness. Horses, whose hoofs have been destroyed by bad shoeing, are, by the use of these "hippo sandals," restored in a short time to their former state of efficiency, and may be used as soon as they are provided with them.

Lond. Mech. Mag. Feb. 1841.



### Manufacture of Carbolein.

The manufacture of this new kind of fuel, invented by M. Weschinskoff, of St. Petersburg (which we have before noticed,) is thus described in the *Moniteur Industriel*:—"It is composed of coal, or of any other combustible, pounded as fine as possible, and mixed with a sufficient quantity of animal or vegetable oil; this mixture is subjected to a strong pressure, in order to produce pieces as hard and solid as stone; from an equal weight this carbolein yields five times more heat than common coal of the best quality. The flame which it produces is very bright, and burns for a long time; this property will render it extremely valuable in foundries, in the manufacture of arms, and in glass works, &c. In short, it will be useful for all purposes where it is important to obtain quickly a hot and continuous fire. It appears from the results of its use on the steam-ship *Sirius*, that the paddle-wheels which made twelve revolutions in a minute with the best coal, made nineteen in a minute when carbolein was used. This new combustible appears then to be very useful, and deserves that further experiments should be made in order to ascertain the accuracy of the results, which are stated to have been arrived at in the experiments already made.

Mining Journ.

### Meteorological Observations for October, 1841.

| Moon.                                                                     | Days | Therm.    |        | Barometer. |        | Wind.     |           | Water fallen in rain. | State of the weather, and Remarks. |
|---------------------------------------------------------------------------|------|-----------|--------|------------|--------|-----------|-----------|-----------------------|------------------------------------|
|                                                                           |      | Sun rise. | 2 P.M. | Sun rise.  | 2 P.M. | Direction | Force.    |                       |                                    |
|                                                                           |      |           |        | Inch's     | Inch's |           |           | Inches.               |                                    |
|                                                                           | 1    | 46        | 64     | 29.90      | 30.00  | NW.       | Moderate. |                       | Clear—do.                          |
|                                                                           | 2    | 46        | 56     | 30.14      | .15    | NE.       | do.       |                       | Cloudy—do.                         |
|                                                                           | 3    | 44        | 42     | 29.86      | 29.86  | E.        | Brisk.    | 1.78                  | Rain—do.                           |
|                                                                           | 4    | 42        | 55     | .86        | .86    | W.        | Moderate. |                       | Cloudy—clear.                      |
| D                                                                         | 5    | 41        | 57     | 30.00      | 30.03  | W.        | do.       |                       | Clear—do.                          |
|                                                                           | 6    | 40        | 58     | .03        | .00    | NW.       | do.       |                       | Clear—do.                          |
|                                                                           | 7    | 42        | 58     | .00        | 29.90  | NW.       | do.       |                       | Clear—do.                          |
|                                                                           | 8    | 52        | 59     | 29.80      | .76    | W.        | do.       | .07                   | Cloudy—rain.                       |
|                                                                           | 9    | 50        | 63     | .76        | .80    | W.        | Brisk.    |                       | Clear—flying clouds.               |
|                                                                           | 10   | 44        | 60     | 30.00      | 30.04  | W.        | Moderate. |                       | Clear—do.                          |
|                                                                           | 11   | 42        | 61     | .04        | 29.96  | SW.       | do.       |                       | Fog—hazy.                          |
| X                                                                         | 12   | 57        | 62     | 29.80      | .75    | SW.       | do.       | .57                   | Rain—cloudy.                       |
|                                                                           | 13   | 49        | 57     | .86        | .90    | NW.       | do.       |                       | Clear—flying clouds.               |
|                                                                           | 14   | 40        | 51     | 30.00      | 30.05  | NW.       | Brisk.    |                       | Clear—flying clouds.               |
|                                                                           | 15   | 41        | 60     | .00        | 29.85  | W.        | do.       | .03                   | Clear—rain.                        |
|                                                                           | 16   | 50        | 54     | 29.90      | .90    | NW.       | Moderate. |                       | Cloudy—do.                         |
|                                                                           | 17   | 36        | 52     | 30.06      | 30.00  | W.N.      | Brisk.    |                       | Clear—do.                          |
|                                                                           | 18   | 35        | 50     | .05        | .10    | W.        | do.       |                       | Clear—do.                          |
|                                                                           | 19   | 34        | 50     | .10        | 29.96  | W.        | Moderate. |                       | Clear—cloudy.                      |
|                                                                           | 20   | 44        | 51     | 29.60      | .47    | SW.       | Brisk.    | .40                   | Rain—clear.                        |
|                                                                           | 21   | 44        | 52     | .43        | .43    | W.        | do.       |                       | Cloudy—do.                         |
|                                                                           | 22   | 41        | 49     | .50        | .50    | W.        | do.       |                       | Clear—cloudy.                      |
|                                                                           | 23   | 40        | 43     | .70        | .70    | W.        | Moderate. |                       | Cloudy—do.                         |
|                                                                           | 24   | 39        | 48     | .70        | .74    | W.        | Brisk.    |                       | Partially cloudy—do.               |
|                                                                           | 25   | 32        | 40     | .95        | 30.05  | W.        | do.       |                       | Clear—flying clouds.               |
|                                                                           | 26   | 28        | 49     | .85        | .00    | W.        | do.       |                       | Clear—do.                          |
|                                                                           | 27   | 38        | 55     | 30.06      | .06    | W.        | Moderate. |                       | Hazy—do.                           |
|                                                                           | 28   | 35        | 50     | .30        | .35    | E.        | do.       |                       | Hazy—do.                           |
|                                                                           | 29   | 46        | 59     | .33        | .30    | SW.       | do.       |                       | Cloudy—partially cloudy.           |
| ☺                                                                         | 30   | 52        | 62     | .26        | .26    | W.S.      | Calm.     |                       | Cloudy—clear.                      |
|                                                                           | 31   | 49        | 63     | .27        | .30    | SW.       | do.       |                       | Fog—lightly cloudy.                |
|                                                                           | Mean | 42.55     | 54.77  | 29.94      | 29.94  |           |           | 2.85                  |                                    |
| Thermometer.                                                              |      |           |        |            |        |           |           |                       |                                    |
| Maximum height during the month, 64.00 $\frac{1}{2}$ on the 1st and 11th. |      |           |        |            |        |           |           |                       |                                    |
| Minimum " " 28.00 " 26th.                                                 |      |           |        |            |        |           |           |                       |                                    |
| Mean 48.66                                                                |      |           |        |            |        |           |           |                       |                                    |
| Barometer.                                                                |      |           |        |            |        |           |           |                       |                                    |
| 30.35 on the 29th.                                                        |      |           |        |            |        |           |           |                       |                                    |
| 29.43 " 21st.                                                             |      |           |        |            |        |           |           |                       |                                    |
| 29.94                                                                     |      |           |        |            |        |           |           |                       |                                    |

FOR THE STATE OF PENNSYLVANIA,  
 Compiled from returns made to the Committee on Meteor-  
 ology of the Franklin Institute of the State of Pennsylv-  
 ania, for

JUNE, 1841.

[illegible]

| Author   | Title                     | Date | Class |
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| P. Q. R. | The PQR's of the Alphabet | 1895 | F     |
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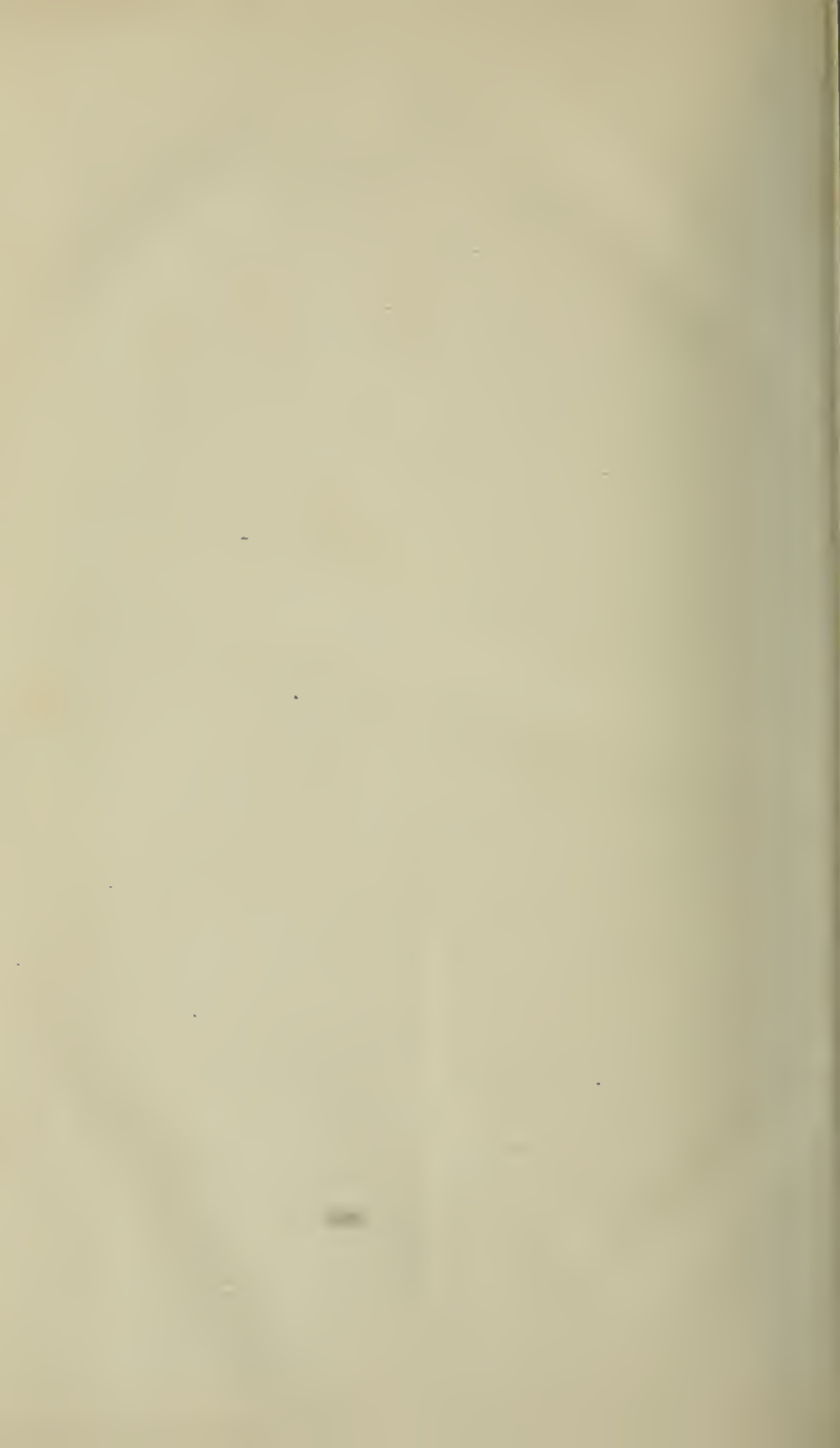


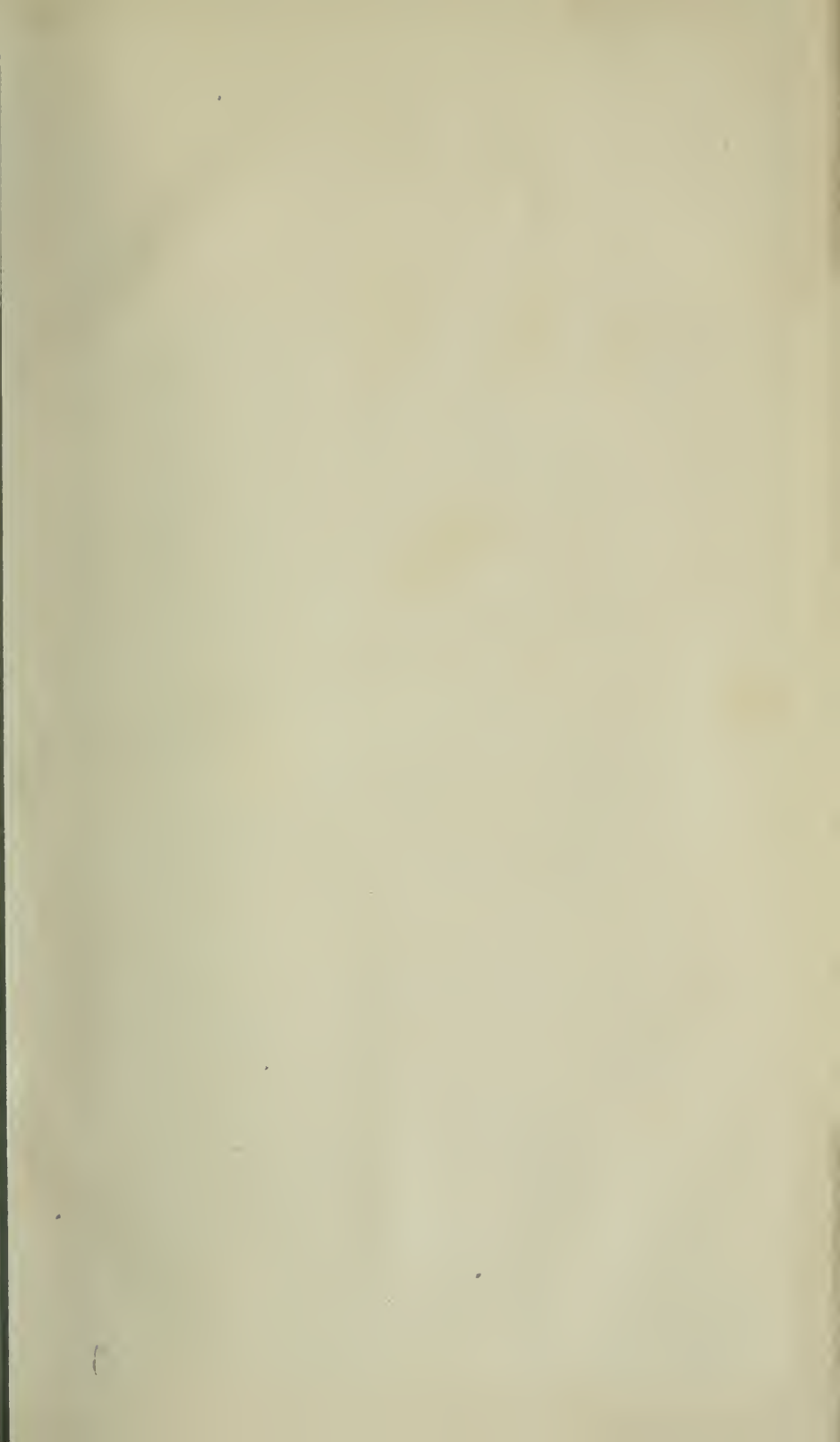
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